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Civilian Radioactive Waste Management System Management and Operating Contractor

HEALTH AND SAFETY IMPACTS ANALYSIS FOR THE MULTI-PURPOSE CANISTER SYSTEM AND ALTERNATIVES

Revision 2

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EXECUTIVE SUMMARY

PURPOSE

This report compares the health and safety impacts of a Civilian Radioactive Waste Management System (CRWMS) that uses the Multi-purpose Canister (MPC) with three alternative systems. The other alternative systems being evaluated are the reference scenario, a dual purpose cask system: the Transportable Storage Cask (TSC) system, and a multi-purpose cask system: the Multi-purpose Unit (MPU) system.

This report is intended to provide information to support the relative comparison of the MPC system and alternative systems. Health and safety estimates are as accurate as current information permits, and, where uncertainties limit the accuracy of estimates, conservative assumptions were made. The same level of conservatism is used for facilities and transportation.

METHODOLOGY

Impacts to public and to occupational health and safety are evaluated. Radiological and non-radiological impacts caused by routine (day-to-day) activities and incidents (accidents) are included. Radiological impacts are measured by the radiological exposure received by persons and non-radiological impacts are measured by fatalities, injuries, and the emission of non-radioactive toxic materials. Health and safety impacts at facilities and during transportation are evaluated separately. Facilities include utility and other spent nuclear fuel (SNF) storage sites (called utilities herein), the Monitored Retrievable Storage (MRS) facility, the cask maintenance facility (CMF), and the Mined Geologic Disposal System (MGDS). Systems were evaluated both with and without an MRS. Health and safety impacts at the utilities, the MRS, and the MGDS are computed from impacts caused by handling spent nuclear fuel (SNF) and SNF casks. The MGDS also includes impacts caused by the handling of vitrified high level waste (HLW) canisters and waste packages. Impacts associated with the CMF result from routine maintenance of contaminated casks. Transportation impacts result from shipping of both loaded and unloaded SNF casks between facilities.

Health and safety impacts are addressed in four areas:

- Radiological Routine Exposures Includes radiation exposure during routine facility operations and during transportation.
- Radiological Incident Exposures Includes radiation exposure from incidents involving SNF fuel, HLW, and cask/canister handling, and from transportation incidents.
- Non-Radiological Routine Impacts Includes routine non-radioactive toxic effluents from facilities and during transportation.
- Non-Radiological Incident Impacts Includes non-radiation-related incidents at facilities and during transportation.

SUMMARY

Table ES-1 illustrates the total system health and safety impacts for both radiological exposure and non-radiological impacts caused by routine activities and incidents. Note that all health and safety impacts are about the same for any of the four alternative systems with the exception of at-facility routine radiological exposures. Routine radiological exposures result in 99.6% of all exposures, with incidents contributing to about 0.4% for any of the alternative systems.

Table ES-1. Total System Health and Safety Impacts (total program)

System Impact Area	Single Purpose Cask System (Reference)	Dual Purpose Cask System (TSC)	Multi-purpose Cask System (MPU)	Multi-purpose Canister System (MPC)
Radiological Routine (person-rem)				
Facilities	42,080	43,820	53,920	56,980
Transportation	1,450	1,450	1,450	1,450
Radiological Incident (person-rem)				
Facilities	0.10	0.08	0.04	0.04
Transportation*	430	430	430	430
Non-Radiological Routine (emissions)				,
• Facilities**	.1 tons	.1 tons	.1 tons	.1 tons
Transportation**	12,290 tons	12,290 tons	12,290 tons	12,290 tons
Non-Radiological Incidents (injuries and fatalities)				
Facilities injuries fatalities	470 4	470 4	470 4	470 4
 Transportation^a injuries fatalities 	132 30	132 30	132 30	132 30

- Notes: a) Values shown include all truck, rail, barge, and heavy-haul.
 - b) Systems approximately the same; within regulatory limits.
 - c) Includes particulates, sulphur and mitrogen oxides, and hydrocarbon vapors that are toxic or potential carcinogens.

Effectively all of the facility radiological exposures are incurred by workers in the nuclear/waste management industries. As can be seen in Table ES-1, the at-facility routine radiological exposures are approximately 35% higher for the MPC system than for the reference scenario. These higher exposures are caused primarily by the MPC welding operations at the utilities and at the MRS. Welding associated operations at these facilities alone contribute to about 85% (12,600 person-rem) of the difference between the MPC system and reference scenario exposures.

Table ES-2 illustrates how routine radiological exposures are distributed among the facilities and transportation. The radiological exposures at the utilities are significantly higher for the MPC system than for the reference scenario (26,000 versus 13,000 person-rem). This is dominated by the welding operations that contribute 11,500 of the person-rem difference. Though not as significant, welding operations at the MRS (1,100 person-rem) have a large impact on the higher MPC system exposures. The dominant impact of a single operation, welding, suggests that the use of automated canister sealing operations or other techniques could significantly lower the MPC and MPU system exposures to be effectively equivalent to those of the reference system.

Table ES-2. Total System Radiological Routine Impacts (person-rem)

	Single Purpose Cask System (Reference)	Dual Purpose Cask System (TSC)	Multi-purpose Cask System (MPU)	Multi-purpose Canister System (MPC)
Facilities: • Utilities	13,110	14,550	25,880	25,660
• MRS	8,200	6,140	7,420	10,700
• CMF	160	140	60	60
• MGDS	20,610	22,990	20,550	20,550
Total	42,080	43,820	53,920	56,980
Transport: Occupational	770	770	770	770
Public	680	680	680	680
Total	1,450	1,450	1,450	1,450
Program Total	43,530	45,270	55,370	58,430

The MGDS exposures caused by the MPU and MPC systems are lower than those caused by the reference scenario and the TSC system. This reduction is a result of additional shielding provided by the canisters during waste package sealing. Because of an additional bolted lid that must be removed while unloading a TSC, the TSC system produces higher exposures at the MGDS than does the reference scenario. The CMF exposures are small for all systems. Transportation exposures are equal for all systems. Public exposure is the same for all systems and makes up less than 2% of the total system exposure.

Health and safety changes with no MRS in any of the alternative systems were also evaluated. Table ES-3 contains the estimated health and safety values with an MRS, and with no MRS.

Table ES-3. With-MRS/No-MRS Total System Health and Safety Impacts (total program)

System Impact Area	Single Purpose Cask System (Reference)	Dual Purpose Cask System (TSC)	Multi-purpose Cask System (MPU)	Multi-purpose Canister System (MPC)
Radiological Routine (person-rem)		10 000 07 510	53,920/50,700	56,980/50,860
Facilities	42,080/40,150	43,820/37,510		1,450/1,430
Transportation*	1,450/1,430	1,450/1,430	1,450/1,430	1,430/1,430
Radiological Incident (person-rem)				0.04
Facilities ^b	0.1	0.08	0.04	0.04
Transportation*	430/410	430/410	430/410	430/410
Non-Radiological Routine (emissions)				
• Facilities ^{b.c}	.1 tons	.1 tons	.1 tons	.1 tons
Transportation ^{a,c}	12,290/9,440 tons	12,29()/9,440 tons	12,290/9,440 tons	12,290/9,440 tons
Non-Radiological Incidents (injuries and fatalities)				
 Facilities injuries fatalities 	470 4	470 4	470 4	470 4
 Transportation^a injuries fatalities 	132/90 30/22	132/90 30/22	132/90 30/22	132/90 30/22

Notes: a) Values shown include all truck, rail, barge, and heavy-haul.

b) Systems approximately the same; within regulatory limits.

c) Includes particulates, sulphur and nitrogen oxides, and hydrocarbon vapors that are toxic or potential carcinogens.

With no MRS there is more storage at some utilities, followed by shipment to a MGDS. With no MRS there were 5% less routine radiological exposures at facilities for the reference scenario as compared to the systems with an MRS. Without an MRS in the TSC system, its facility routine exposures were less than the exposures of the Reference scenario with no MRS, and the lowest of all of the alternatives. With no MRS the MPC system routine exposures were 15% less than the exposures of an MPC system with an MRS. The facility radiological incident exposures, nonradiological emissions, injuries and fatalities did not change significantly whether with an MRS or with no MRS. Transportation routine exposures were 5% lower for all alternatives with no MRS, compared to systems with an MRS. Transportation had 23% less nonradiological emission, 25% fewer fatalities, and 32% fewer injuries with no MRS, compared to the systems with an MRS.

CONCLUSIONS

Table ES-1 shows that all health and safety impacts are effectively equivalent for any of the four alternative systems with the exception of routine radiological exposures at facilities. Effectively all of the facility radiological exposures are incurred by workers in the nuclear waste management industries.

As can be seen in Table ES-1, the total routine radiological exposures at facilities are 35% higher for the MPC system than for the reference scenario (57,000 versus 42,000 person-rem). These higher exposures are dominated by the MPC welding operations at the utilities and at the MRS. Welding operations at these facilities alone contribute about 85% (12,600 person-rem) of the difference between the MPC and reference scenario exposures. Total exposures are small relative to expected background radiation exposures (e.g., natural sources, medical uses, radon, etc.) to the U.S. population of 3.5 billion person-rem over the same period of time as the CRWMS program.

Table ES-2 shows that the radiological exposures at the utilities are almost 2 times higher for the MPC system than for the reference technology (25,700 versus 13,100 person-rem). The MPC at-utility exposures again are dominated by welding operations that contribute to 70% (11,500 out of 13,000) of the person-rem difference.

The majority of the increased exposure caused by the MPC system is related to one operation: canister welding. The reference system, on the other hand, is not dominated by a single source or activity so there is no specific opportunity for significant exposure reduction. This strongly suggests that the application of automated canister sealing operations or other techniques could significantly lower the MPC system exposures to be effectively equivalent to those of the reference scenario.

Table ES-3 indicates that with no MRS the evaluated system health and safety impacts will decrease or remain the same for all of the alternative systems. The magnitude of the results for the systems without an MRS are similar to those with an MRS (e.g., for MPC system; 56,970 person-rem with an MRS and 50,860 person-rem with no MRS.) The MPC facility health and safety impacts for systems with no MRS are higher than for the reference scenario with no MRS. In addition, the MPC facility health and safety impacts for systems with an MRS are higher than for the reference scenario with an MRS.

This report estimates the impacts to health and safety associated with operations and procedures as they are currently defined on the basis of nuclear power industry technology demonstrations, current practice, and estimation procedures as described in Appendix A. The development and use of as low as is reasonably achievable (ALARA) techniques can reduce the estimated health and safety impacts in all areas for all alternative systems. Financial costs, schedule impact, and public acceptance should be considered in final decisions determining where and when ALARA techniques are implemented.

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1. INTRODUCTION

1.1 BACKGROUND

The Office of the Civilian Radioactive Waste Management (OCRWM) of the U.S. Department of Energy is developing a Multi-purpose Canister (MPC) system. The MPC system relies on the use of a clean, sealed metal canister for all Civilian Radioactive Waste Management System (CRWMS) operations including storage, transportation, and disposal. The MPC system is being developed as an alternative to systems relying on a single purpose cask design. Other alternatives being evaluated are a dual purpose cask system: the Transportable Storage Cask (TSC) system, and a multi-purpose cask system: the Multi-purpose Unit (MPU) system.

As a result of the initial findings in the study "A Preliminary Evaluation of Using Multi-purpose Canisters within the Civilian Radioactive Waste Management System," (Reference 58) the CRWMS Management and Operating (M&O) contractor was directed to evaluate the MPC system design against the reference scenario for other alternatives. This information is provided to OCRWM for use regarding the development of an MPC system.

1.2 OBJECTIVE

The objective of this report is to determine and compare the health and safety impacts caused by the reference scenario, the MPC, the TSC, and the MPU alternative systems. The results provide information for use in the continuing development of the MPC system.

1.3 SCOPE

This report provides information to support the relative comparison of the MPC system and alternative systems. Health and safety estimates are as accurate as current information permits, and, where uncertainties limit the accuracy, conservative assumptions have been made.

Health and safety impacts evaluated include both radiological and non-radiological impacts on the public and occupational workers within the CRWMS. Radiological impacts are measured by the radiological exposure received by persons and non-radiological impacts are measured by injuries, fatalities, and the emission of toxic materials. Impacts caused by both routine (day-to-day) activities and incidents (accidents) are considered. Total health and safety impacts are computed by combining logistics data with impacts associated with processing spent nuclear fuel (SNF) and high level waste (HLW). Four CRWMS systems are evaluated for their health and safety impacts: the reference scenario, the MPC system, the TSC system, and the MPU system. The reference scenario and MPC systems are defined in the report "Concept of Operations for the Multi-purpose Canister System," (Reference 55). The TSC and MPU systems are defined in the report "Evaluation of Alternative Cask/canister Systems," (Reference 65). Logistics data are in the report "Operational Throughput for the Multi-purpose Canister System," (Reference 57). Health and safety impacts are evaluated for systems with and without a monitored retrieval storage facility (MRS).

1.4 QUALITY ASSURANCE

A QAP-2 analysis has determined that this activity is not quality affecting. The analysis is documented in the Reference 61.

2. APPROACH

Health and safety impacts are evaluated for four alternative systems: the reference scenario, the MPC system, the TSC system, and the MPU system. Each system is responsible for managing SNF from the utility storage pool to final emplacement and the processing of HLW from the time it is delivered to the repository through emplacement. Both public and occupational health and safety impacts are considered. Radiological and non-radiological impacts caused by routine (day-to-day) activities and incidents (accidents) are included. Radiological impacts are measured by the radiological exposure received by persons and non-radiological impacts are measured by injuries, fatalities, and the emission of toxic materials.

Health and safety impacts at the utility storage sites, the Monitored Retrievable Storage (MRS) facility, and the Mined Geologic Disposal System (MGDS) are computed from impacts caused by handling SNF and SNF casks. The MGDS also includes impacts caused by HLW and waste package handling. Transportation impacts result from the shipping of both loaded and unloaded SNF casks between facilities. Impacts associated with the cask maintenance facility (CMF) result from routine maintenance of contaminated casks. Systems with and without an MRS are evaluated.

Health and safety impacts are addressed in four areas:

• Radiological Routine Exposures - Includes radiation exposure during routine facility operations and during transportation.

• Radiological Incident Exposures - Includes radiation exposure from incidents involving SNF fuel, HLW, and cask/canister handling, and from transportation incidents.

• Non-Radiological Routine Impacts - Includes routine non-radioactive toxic effluents from facilities and during transportation.

• Non-Radiological Incident Impacts - Includes non-radiation related accidents at facilities and during transportation.

Results are compared within each impact area and in the aggregate.

This report evaluates the impacts to health and safety associated with operations and procedures as they are currently defined on the basis of technology demonstrations, current practice, and nuclear power industry procedures for Nuclear Regulatory Commission (NRC) license application as described in Appendix A. The routine exposure estimates are conservative by about 10 times both for the facilities and for transportation. The development and use of as low as is reasonably achievable (ALARA) techniques can reduce the estimated health and safety impacts in all areas for all alternative systems. Measurements at a utility for operational use of multi-element storage containers (MESCs) has shown that as low as 10% of the estimates could be achieved. Financial costs, schedule impact, and public acceptance should be considered in final decisions determining where and when ALARA techniques are implemented.

2.1 METHODOLOGY

Radiological and non-radiological health and safety impacts caused by both routine activities and incidents are evaluated. All radiological impacts are measured by the radiological exposure received by persons and all non-radiological impacts are measured by injuries, fatalities, and emission of toxic materials. Health and safety impacts caused by activities at the CRWMS facilities and those caused by transportation are addressed separately.

2.1.1 Facility Health and Safety Impacts

Health and safety impacts are determined for the utility storage sites, the MRS, the CMF, and the MGDS. Facility health and safety impacts to occupational workers are computed only for the time the workers spend within a facility. Occupational workers are defined as all badged employees including subcontractors, temporary employees, and suppliers. The public will incur health and safety impacts from facility operations only when outside the facility, taking VIP tours within a facility, or at facility visitor centers.

Radiological exposures caused by routine activities within a facility are computed based on inputs from the CRWMS design organizations. This information includes the type of operations performed at each facility, the radiological exposures per operation, the number of workers required, and the total number of operations. Radiological exposures caused by incidents at a facility are based on the number of fuel and cask handlings coupled with the probability of events and potential radiological releases. High level waste (HLW) was considered, from its arrival at the facility entrance control point.

Non-radiological impacts at each facility include injuries, fatalities, and the emission of toxic materials. Injuries and fatalities are computed by combining the man-years worked at all facilities with data for industrial accidents.

2.1.2 Transportation Health and Safety Impacts

Transportation health and safety impacts are computed for the shipment of both loaded and unloaded SNF casks. Truck, rail, barge, and heavy-haul modes of transportation are included.

Radiological exposures caused by routine activities or by incidents during transportation are evaluated using the RADTRAN 4 computer code (Reference 48). The INTERLINE (Reference 29) and HIGHWAY (Reference 30) transportation routing codes are used to compute the demographic characteristics of each route. These include the distances, the population densities, and the portions that are rural, suburban, or urban. These values are computed using the 1990 block-census data. Transportation of HLW was outside the scope of this analysis.

Non-radiological impacts caused by routine transportation are evaluated based on the projected emissions from the vehicles used. See "An Assessment of the Safety of Spent Nuclear Fuel Transportation in Urban Environments," (Reference 43). Emission estimates assume that pollution control technologies and engine efficiencies remain fixed at 1982 levels. Non-radiological impacts caused by incidents are computed from shipment miles combined with transportation accident data.

2.2 ASSUMPTIONS

The system parameters and assumptions used for the reference scenario and the MPC system are defined in the report "Concept of Operations for the Multi-Purpose Canister System report," (Reference 55). Assumptions for the TSC and MPU systems are contained in the study "Evaluation of Alternative Cask/Canister Systems," (Reference 65). Throughput assumptions for SNF and SNF casks/canisters are taken from the report "Operational Throughput for the Multi-purpose Canister System," (Reference 57).

The radiation exposure inputs developed by the design organizations can be found in Appendix A, Facility Routine Radiation Exposures. The transportation mode characteristics used with RADTRAN 4 are those of the expected CRWMS operating practices, listed in Appendix B. Fuel characteristics assumptions and lists of related isotopes are included in Appendix C. Information about the MGDS are in Appendix D. Remaining assumptions are stated in the individual sections of the report.

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3.1.2 Routine Exposures at the MRS

Table 3-3 shows the exposures incurred at the MRS for each of the alternative systems. The exposures from the TSC and MPU systems are lower than those from either the reference scenario or the MPC. This is because the reference scenario requires more cask loadings and unloadings and the MPC requires overpack exchanges. The MPC system exposures are higher than the reference scenario because of MPC welding and an increased number of storage operations, caused by the smaller MPC storage capacities relative to reference scenario storage casks, as well as overpack exchanges.

Table 3-3. MRS Radiological Routine Exposures (person-rem)

•	Single Purpose Cask System (Reference)	Dual Purpose Cask System (TSC)	Multi-purpose Cask System (MPU)	Multi-purpose Canister System (MPC)
Truck casks	2,590	2,590	2,590	2,590
Storage and rail casks	4,860	2,930	4,210	7,490
Radioactive waste	750	620	620	620
Total	8,200	6,140	7,420	10,700

3.1.3 Routine Exposures at the CMF

Routine radiological exposure to occupational workers at the cask maintenance facility (CMF) occurs during routine maintenance of contaminated casks. It is assumed that every cask in the transportation cask fleet will return to the CMF for routine maintenance three times in a given year. This is typically once per campaign. The cask fleet size is defined in the "Operational Throughput for the Multi-Purpose Canister System," report (Reference 57). Exposures at the CMF are estimated as 20 person-millirem for cleaning the inside and the outside of the TSCs and the transportation casks associated with the reference scenario. A 5 person-millirem exposure is expected for cleaning the transportation overpacks associated with the MPC system since they transport clean sealed canisters. Total exposure at the CMF is 155 person-rem for the reference scenario, 141 person-rem for the TSC system, 58 person-rem for the MPC system and 58 person-rem for the MPU system. These exposures are relatively small.

3.1.4 Routine Exposures at the MGDS

Table 3-4 shows the routine exposures incurred at the MGDS. MGDS exposures include SNF and HLW receipt, preparation in waste packages, emplacement, followed by the potential retrieval, inspection, and re-emplacement of 10 waste packages per year, and the monitoring of the waste packages. The activities are still largely to be defined.

The reference scenario, MPU and MPC system exposures are lower than those caused by the TSC systems. Because of an additional bolted lid that must be removed while unloading a TSC, the TSC system produces higher exposures at the MGDS than does the reference scenario.

Table 3-4. MGDS Radiological Routine Exposures (person-rem)

	Single Purpose Cask System (Reference)	Dual Purpose Cask System (TSC)	Multi-purpose Cask System (MPU)	Multi-purpose Canister System (MPC)
Truck casks	390	390	390	390
Rail casks	18,250	20,810	18,380	18,380
HLW casks	730	730	730	730
Radioactive facility waste	1,040	860	860	860
Retrieve, inspect and replace WPs	200	200	200	200
Monitor WPs	<1	<1	<1	<1
Total	20,610	22,990	20,560	20,560

Exposures related to HLW are the same for all of the alternative systems. The Characteristics Data Base shows that averaged over the fleet, a HLW canister has an average gamma flux rate that is about one third of the flux from an average SNF assembly. Most exposure, to a first order magnitude, is attributed to the closest assembly or canister. Until more detailed data is available, it is assumed that the exposures to unload and handle a HLW shipment are one third of the exposures for a truck SNF cask.

Exposures from HLW are about 4% of the total exposure incurred at the MGDS. This evaluation assumes 4 HLW carristers per waste package. Handling of the HLW, including the loading of waste packages, provides about 1% of the total CRWMS exposures.

Assuming a .01 person-millirem exposure per package per year, monitoring produces a negligible fraction of the MGDS totals. Retrieval, inspection, and re-emplacement of waste packages are essentially undefined activities at this time but are expected to result in exposures of about 1% of the total MGDS exposures.

Exposures for all MGDS operations have a higher degree of uncertainty than those at the utilities, the MRS, or the CMF because many of the MGDS specific design and operation decisions are not as well developed.

3.1.5 Routine Exposures to the Public

The routine radiological exposures of the public near facilities handling spent fuel are extremely low. Public exposures result from the release of radioactive gases during facility operation, and visits by the public to the facilities. The routine exposures due to radioactive gas discharges depend on the handling and storage technology selected, such as single-purpose cask, TSC, MPU and MPC for the Single-Purpose, Dual-Purpose, and Multi-purpose Systems, respectively. In contrast, the exposures to visitors depend on discretionary choices by individual members of the public, for each visit.

3.1.5.1 Exposures Resulting From Releases of Radioactive Gases

Normal operations at spent fuel storage sites result in the occasional release of radioactive gases into the atmosphere. Reference 54 assumes that radioactive gases are emitted during handling of fuel assemblies in spent fuel storage pools, and in dry transfer cells. Conservatively, the gases are assumed to be released in the proportions described in References 54 and 68. It is assumed that no releases take place from sealed casks and canisters, except in severe incidents.

The action of handling a fuel assembly is assumed to cause a release of radioactive gases for a susceptible fraction of the assemblies handled. This assumes that all fuel assemblies are handled with care, in compliance with authorized procedures. An NRC estimate of the conservative, design-basis gas fractions release from a ruptured fuel assembly is provided in Reference 68. Less severe releases would follow less severe damage, i.e., the if only one fuel pin were vented per incident, the estimate based on the NRC guide could be conservative by 100 to 200 times. Information about the build-up and decay of radioactive gases in spent fuel pins are in Reference 69. The exposure, at the facility perimeter, per fuel assembly release for each facility type were from Reference 54.

Public exposures were estimated for the people within a ten miles radius of the facilities, based on 10 CFR Part 50 Appendix E which describes the emergency planning zones for radioactive gas releases for nuclear power plants. The potential routine exposure to the public near each facility are the product of the number of bare fuel assemblies handled at each type of facility, multiplied by the probability of a release per handling, times the potential exposure per gas release, times an average dilution rate as the gases reach the surrounding area, and finally multiplied times the average population density within the 10 miles radius.

A conservative dispersion dilution trend for surface releases was obtained from Reference 68. Reference 54 assumes a probability that 2.5×10^4 multiplied times the number of fuel assemblies handled may vent radioactive gases. The numbers of bare spent fuel assemblies handled and probably vented at the facilities are shown in Table 3-5.

Table 3-5. Bare Fuel Assemblies Handled/Vented at Each Facility Type

Facility Type	Single-Purpose System (Reference)	Dual-Purpose System (TSC)	Multi-purpose Systems (MPC and MPU)
Spent Fuel Pool	364,770/91	308,210/77	308,210/77
MRS Facility	121,970/30	31,500/8	31,500/8
MGDS	298,310/75	298,310/75	5,000/2

The radioactive gases released from vented spent fuel assemblies have long half-lives and are dispersed in the air. The offsite dose consequences associated with the venting of all of the fuel rods of one spent fuel assembly (PWR) are shown in Tables 3-6 and 3-7, assuming a site boundary distance of 800 meters, and an atmospheric dispersion factor per Reference 68, NRC Regulatory Guide 1.25. Table 3-7 applies to the program life cycle. The assumed release fractions, type of spent fuel (PWR) and dispersion factors are conservative.

Table 3-6. Maximum Individual Site Boundary Doses per Single (PWR) Fuel Assembly (based on 800 meters to site boundary, References 54 and 68)

Gases (Krypton, Tritium, Iodine)	micro-rems
Vented in Dry Environment	1.00
Vented in Pool	1.03

Table 3-7. Maximum Individual Estimated Doses from All Bare Fuel Assemblies Events (micro-rems)

Facility Type	Single-Purpose System (Reference)	Dual-Purpose System (TSC)	Multi-purpose Systems (MPC and MPU)
Spent Fuel Pool (all transfers)	9.1	7.7	7.7
MRS Facility (transfer-cell)	30	8	8
MGDS(transfer-cell)	75	75	2

10 CFR Part 72 will be complied with. Exposure at each utilities, MRS and MGDS boundaries will be less than 25 millirem per year (25,000 micro-rem/year). 40 CFR Part 61 will also be complied with, which requires that exposure from normal operation airborne emissions from each

facility to any member of the public must be less than 10 millirem per year (10,000 micro-rem/year).

Public exposures were estimated for each facility type by integrating the dose as a function of distance (assuming the wind dispersion factors of Reference 68) over the population within radial distances from 2500 feet of the spent fuel location, out to a distance of 10 miles to obtain the population doses shown in Table 3-7. The average population density within 10 miles radius of the utility controlled area is estimated as 170 people per square mile, and conservatively assumed to be uniformly distributed. The population density was estimated from data in Reference 70. For a Western MRS facility in a rural area, in the vicinity of a route that can be used for transporting spent fuel, typical population densities were estimated by using the HIGHWAY and INTERLINE computer codes. The population data are 1990 block level census data. West of the Mississippi River and East of the states of California, Oregon, and Washington, an average population density about 5 people per square mile is representative. About 3 person per square mile near an MGDS in a Western remote rural area is plausible, assuming that the conditions near Yucca Mountain, NV are representative.

Table 3-8. Estimated Population Dose During the Life of the Program (Bare Fuel Assemblies Vented When Handled at Each Facility Type) (units are person-millirem)

Facility Type	Single Purpose System (Reference)	Dual-Purpose System (TSC)	Multi-purpose Systems (MPC and MPU)
Spent Fuel Pool	3.4	2.87	2.87
MRS Facility	0.33	0.09	0.09
MGDS	0.49	0.49	0.013
Program total, person-rems*	4.22	3.45	2.97

^{*}totals are rounded.

3.1.5.2 Exposures Resulting From Public Visits

The program architecture includes visitor centers at the MRS facility and the MGDS. An estimate was prepared to illustrate the magnitudes of possible exposures to visitors at the facilities. The visitors are assumed to receive less than 1 mrem per person (equivalent to an exposure during a jet aircraft trip of 2500 miles), assuming one 6-hour visit per person. The tourist visitor rate is assumed to be 3 people per day. Therefore, the total for all tourists is less than 1 person-rem/year. Very Important People (VIP, e.g., stakeholders) visitors may be offered more extensive tours with exposures equivalent roughly to a "medical chest x-ray" (50 mrem). Doses to 10 VIPs per year can total about 0.5 person-rem/year. The total for visitors is roughly (1+0.5) x 40 = 60 person-rems during 40 years of MGDS operation, and about 45 person-rems at the MRS facility

during approximately 30 years of operation. There is no comparable plan for waste disposal related visitor centers at the utility spent fuel storage areas.

3.1.5.3 Summary of Routine Public Exposures

The primary exposure of the public at the facilities may be primarily from routine visits by the public, including stakeholders and VIPs, (about 105 person-rems) rather than from facility radioactive gas emissions (3.0 to 4.3 person-rems).

3.2 RADIOLOGICAL INCIDENT EXPOSURES

Unplanned contact or "bumping" during the lift-handling (lift and movement) of casks, canisters, or fuel assemblies is the key factor associated with incident exposure. Lift-handling combines a significant possibility of an incident, with gravitational potential or speed sufficient to cause personnel injuries and/or radiological release.

A comprehensive review of NRC reports was undertaken to determine the observed rate of lift-handling events, see References 12, 13, 15, and 17 through 28. Other pertinent technical reports (References 5, 29, 33, 34, 36, 37 and 54) were also reviewed. Lift-handling incidents within a transfer facility were reported to have a probability of 10⁴. For incidents that occur within design conditions, the probability of radiological release is less than 10⁴ for each incident. All crane operations and all on-site movements of casks, canisters, and SNF are assumed to be well within design limitations. Therefore, the cumulative probability of lift-handling incidents causing radiological release is less than 10⁸ per operation, see Reference 55.

3.2.1 Radiological Exposures from SNF Handling Incidents

It is assumed that only lift-handlings can create an environment that can result in the damage to fuel assemblies and the possible release of radioactive material. Other types of handlings are not included in this evaluation.

A total of about 298,000 SNF assemblies, containing 86,000 MTU, are projected to be discharged from reactors over the lifetime of the program.

3.2.1.1 Incidents from SNF Handlings in the Reference Scenario

For the reference scenario all fuel assemblies at the utilities are lift-handled at least once when loading transportation or storage casks. Assemblies loaded into dry storage (about 10%) must be lift-handled two more times: once for unloading the assembly from the dry storage cask and again for reloading it into the transportation cask. Because not all assemblies will pass through the MRS, thirty percent of the SNF assemblies are lift-handled at the MRS for storage and repackaging. All fuel assemblies are lift-handled at least once at the MGDS to load the waste packages. There are about 2.5 lift-handlings for every fuel assembly. Approximately 74 fuel assemblies may fall or be bumped, combined for the activity at the utilities, MRS and MGDS. See Reference 6.

3.2.1.2 Incidents from SNF Handlings in the TSC System

For the TSC system all fuel assemblies are lift-handled at least once to load TSCs at the utilities. Fuel assemblies loaded into truck casks (about 10%) require one more lift-handling at the MRS. All fuel assemblies are lift-handled at least once at the MGDS to load waste packages. There are approximately 2.1 lift-handlings for each fuel assembly. Approximately 62 fuel assemblies, combined for the activity at the utilities, MRS and MGDS, may fall or be bumped.

3.2.1.3 Incidents from SNF Handlings in the MPC and MPU Systems

For the MPC and MPU systems all fuel assemblies are lift-handled at least once to load the MPC or MPU at the utilities. Fuel assemblies loaded into truck casks (about 10%) require one more lift-handling at the MRS. A few fuel assemblies (0.5%) are lift-handled one more time at the MGDS to load waste packages. There are approximately 1.1 lift-handlings for each fuel assembly. Approximately 33 fuel assemblies, combined for the activity at the utilities, MRS and MGDS, may fall or be bumped.

3.2.1.4 Expected Exposures from SNF Handling Incidents

If a gas release from a single spent fuel assembly occurs following a lift-handling incident, the site boundary exposure, i.e., diluted over the facility, is expected to be no more than 10^{-6} rem at an MRS or MGDS. See Reference 55, "Monitored Retrieval Storage (MRS) Conceptual Design Report," May 1, 1992, Volume II, Book II. Particles would be trapped by the High Efficiency Particle (HEPA) filters. Personnel are assumed to be uniformly distributed, in the absence of specific information about site layouts relative to the average wind direction and so forth.

Based on the expected number of lift-handling incidents, the cumulative rem are about 3.3 x 10⁻⁵ for the MPU and MPC systems, about 6.2 x 10⁻⁵ for the TSC system, and about 7.4 x 10⁻⁵ for the reference scenario. These exposures are within the 5 rem exposure limit for accidents stated in 10CFR72. The total person-rems on-site are estimated from the release and the population data. Assuming that the MRS with the CMF have 750 full time equivalent (FTE) staff, the MGDS has about 500 in the surface facility (see Section 3.4 of this report), and about 50 FTE at utilities, the occupational incident person-rem exposures of the program are about 0.043 for the MPU and MPC systems, 0.081 for the TSC system, and 0.10 for the reference scenario.

As a result of the decreased number of fuel assembly handlings in the MPU and MPC systems, radiological incident impacts as a result of fuel assembly handlings are lower for the MPU and MPC systems relative to the TSC system and reference scenario. The expected incident expessures for all of the systems are below regulatory limits and practically equivalent.

3.2.2 Radiological Impacts from Cask Handling Incidents

It is assumed that only lift-handlings of casks can create an environment that can result in the damage to a cask and the possible release of radioactive material. Other types of cask handlings are not included in this evaluation. Because the facility handling equipment and procedures are the same, the handling incident severities are expected to be equivalent for the alternatives. Cask

handling incidents and resulting health and safety impacts are evaluated for the MPC system as an illustrative example.

3.2.2.1 Expected Cask Handling Incidents

As a result of the canister overpack transfer operations, the MPC system requires the maximum number of cask/canister handlings. MPC lift-handling operations include placing the MPC into an overpack as well as lifting the MPC alone.

All MPCs, approximately 10,000, that originate at the utilities are lift-handled at least twice for loading. MPCs loaded at facilities limited by a 100-ton crane capacity (16%) require a transfer cask and are lift-handled one additional time. About 40% of the MPCs are loaded into dry storage and must be lift-handled once from the transfer cask into dry storage and once from dry storage into a transportation cask. MPCs that flow into MRS storage from the utilities (15%) are lift-handled four additional times: MPC cask from rail car into transfer facility, MPC from transport cask to storage mode, and the reverse steps. Approximately 1000 MPCs originating at the MRS, due to loading SNF from truck casks, require 1.5 lift-handlings each. All MPCs are lift handled four times at the MGDS: MPC cask from rail car to surface facility, MPC from transfer cask to disposal container, MPC disposal container from facility to transporter, and MPC transporter to emplacement position in a drift.

Thus, there are about 7.5 lift-handlings per MPC loaded at the utility sites, 5.5 lift-handlings per MPC loaded at the MRS, and 4 lift-handlings per MPC at the MGDS. This is about 150,000 total cask/canister lift-handlings. With crane reliability of about 10⁴ incidents per hour, and about 0.2 hours per handling, then 3 casks or canisters may fall or be bumped, for the combined locations.

3.2.2.2 Expected Exposures from Cask Handlings Incidents

Since the probability of radioactive release from an incident that occurs within design specification is less than 10⁻³ and exposures from a cask handling incident are estimated to be 10⁻⁶ person-rems, (Reference 55) exposure caused by the lift-handling of SNF casks and canisters is expected to be in the range 10⁻⁶ to 10⁻⁹, (i.e., near zero).

Canisters of vitrified HLW will also be handled at the MGDS. The total number of HLW canister packages is estimated to be on the same order as the number of MPC waste packages. HLW canisters have an improved incident response over SNF canisters. We therefore expect radiological releases involving HLW incidents to be less than those involving SNF.

It is estimated that all cask/canister handling incidents result in negligible exposure for all of the systems.

3.3 NON-RADIOLOGICAL ROUTINE IMPACTS

Non-radiological impacts are measured by injuries, fatalities, and the emission of toxic materials. Both routine activities and incidents may cause non-radiological impacts to both the public and occupational workers.

3.3.1 Routine Non-Radiological Impacts to CRWMS Occupational Workers

Non-radiological routine impacts such as noise, dust, and on-site engine exhaust pollution are assumed to affect only occupational workers and to be within regulatory limits for all of the systems.

3.3.2 Routine Non-Radiological Impacts to the Public

Non-radiological routine impacts to public health and safety are caused by non-radioactive effluents routinely released from a facility. All effluents produced at facilities are assumed to be within regulatory limits at the boundaries of each facility. Based on an estimated order of magnitude 5 pounds per year release of airborne particulates and other potentially toxic or carcinogenic emissions (SO_x, NO_x and hydrocarbons), facilities prime-movers used for movement of on-site leaded and unloaded cask and canisters will produce about 0.1 tons of such emissions for a 40-year program based on the data of Reference 43. These emissions will be essentially equal for all alternative systems because the facilities to be operated will be very similar.

3.4 NON-RADIOLOGICAL INCIDENT IMPACTS

Industrial accidents pose a non-radiological impact to the health and safety of occupational workers. The accident rate for the nuclear power industry in 1992 was about 0.38 per 100,000 manhours. See Reference 38, "Power Engineering Journal," June 1993. Since there were no fatalities reported in that year, the statistics indicate the injuries, and a lower-bound statistical limit on the probability of a fatality at less than 1 per 100,000 hours. Since the number of manhours are comparable for all systems, non-radiological incident impacts for facilities are essentially the same for all of the systems.

For a combined MRS and CMF facility consisting of 750 full time equivalent (FTE) employees, Reference 57, we expect about 5.7 accidents per year, for a total of 165 for an MRS 29-year period of operation. For an MGDS facility consisting of about 500 FTEs for the surface facilities, and about 500 for all underground operations, we expect about 7.6 industrial accidents per year at the same accident rate, Reference 38, for a total of 304 for a 40 year program. The total facility accidents for the MRS, CMF, and MGDS are therefore estimated to be about 469. Fatalities are computed using an on-the-job fatality rate of 0.03 fatalities per 1,000,000 hours worked, based on an average across all U.S. industries (Reference 67). The fatalities total roughly 4 for the lifetime of the program, for any of the systems.

3.5 FACILITY HEALTH AND SAFETY IMPACTS FOR NO MRS (DIRECT SHIPMENT)

With no MRS, the direct shipment of SNF to the MGDS, without an MRS in the system, has little impact on the overall facility health and safety impacts as shown by the pairs of values with-MRS/no-MRS in Tables 3-9. Most of the activities formerly carried on at the MRS, and the exposures, are shifted to the utilities as shown in Table 3-10. Changes in the transportation exposures and nonradiological risks, are described in section 4.6.

Table 3-9. With-MRS/No-MRS Facility Health and Safety Impacts (total program)

System Impact Area	Single Purpose Cask System (Reference)	Dual Purpose Cask System (TSC)	Multi-purpose Cask System (MPU)	Multi-purpose Canister System (MPC)
Radiological Routine (person-rem) • Facilities	42,080/40,150	43,820/37,510	53,920/50,700	56,980/50,860
Radiological Incident (person-rem) • Facilities*	0.1/0.1	0.08/0.08	0.04/0.04	0.04/0.04
Non-Radiological Routine (emissions) • Facilities ^{a,b}	.1/.1 tons	.1/.1 tons	.1/.1 tons	.1/.1 tons
Non-Radiological Incidents (injuries and fatalities)				
 Facilities injuries fatalities 	470/470 4/4	470/470 4/4	470/470 4/4	470/470 4/4

Notes: a) Systems approximately the same; within regulatory limits.

Table 3-10. No MRS (Direct Shipment) Facility Health and Safety Routine Impacts (person-rem)

	Single Purpose Cask System (Reference)	Dual Purpose Cask System (TSC)	Multi-purpose Cask System (MPU)	Multi-purpose Canister System (MPC)
Facilities: • Utilities	17,380	12,720	28,940	28,270
• CMF	160	140	60	60
• MGDS	22,610	24,650	21,700	22,530
Program Total	40,150	37,510	50,700	50,860

b) Particulates, sulphur, nitrogen oxides, and hydrocarbon vapors that are toxic or potential carcinogens.

4. TRANSPORTATION HEALTH AND SAFETY IMPACTS

The most visible public health and safety effect will result from transportation. The four alternative systems, the reference scenario, and TSC, MPU, and MPC systems, assume the same transportation modal splits and effectively the same transportation cask capacities. As a result the transportation health and safety impacts are the same for all of the alternative systems. This chapter presents a single set of health and safety impacts that are applicable to any of the alternative systems.

It is assumed that 63,000 MTU of SNF are shipped through a generic western MRS to a first MGDS. For the purpose of this evaluation, the first MGDS is assumed to be located at Yucca Mountain, NV. An additional 23,000 MTU will be shipped directly to a generic western MGDS. Health and safety impacts during vitrified HLW transportation to the MGDSs are the same for all systems and are not evaluated here.

For each SNF storage site, the mode of transportation selected (truck, rail, barge, and heavy-haul) and travel distances are based on References 56 and 60. The capacities of PWR and BWR fuel casks are obtained from References 56 and 59.

Using these data the cask-miles traveled from each site are estimated. Radiological exposure impacts are estimated using U.S. Department of Transportation (DOT) data, the RADTRAN transportation radiation exposure code, and population densities along the routes. Any benefits caused by safety measures, such as the use of police or security escorts for trucks traveling in high population density areas, are excluded from the estimates.

Radiological routine and incident exposures for transportation shipments are estimated by using the RADTRAN 4 computer code, Reference 49. The transportation characteristics are based on the expected CRWMS operating practices, which are listed in Appendix B. INTERLINE (Reference 31) and HIGHWAY (Reference 32) transportation routing codes, using 1990 Census data, compute population densities along each route and the fraction of each route that is rural, suburban, or urban. These values are used in the RADTRAN estimates. The rail, barge, and heavy-haul routes follow commercial practices.

All truck trips are assumed to be carrying loaded casks from the SNF sites to the MRS or MGDS and empty casks on return trips. Trucks are assumed to be combination type tractor-trailers with a cab and a single attached cask-carrier. A two-person crew is assumed for each truck. Routes used comply with HM-164 and use non-interstate highways only for local access to or from the interstates. Statistics for this class of vehicle and highways used in the evaluations were based on DOT data.

Rail shipments are by dedicated train with 3 casks carried between the utilities and the MRS and 5 casks between the MRS and MGDS. Estimates of damage to SNF casks carried by rail are based on DOT data indicating that typically only 1.03 hazardous material cars are damaged per accident involving trains hauling hazardous materials. The damage rate was independent of the number of hazardous material cars in each train and the total number cars in each train.

Heavy-haul truck transporters are used at utility storage sites to carry large rail casks to a nearby rail siding for transfer onto rail cars. At a few locations heavy-haul vehicles are transported on a barge from a dock near an SNF site to a dock near a rail siding. Each barge is assumed to carry 4 heavy-haul transporters, with 1 large rail cask each. Barge and heavy-haul vehicles are assumed to transport only loaded large (100 tons or greater) rail casks. DOT accident statistics for barge shipments on inland waterways, (such as rivers, barge canals, and the Great Lakes) are used in the evaluations. Heavy-haul accident statistics are derived from those used for trucks, with a reduction for the lower speeds and protected movement of the heavy-haul vehicles. Data are provided in Appendix B.

All transportation health and safety estimates are for the operational life cycle of the program. There are no known transportation health and safety impacts that depend on the annual shipment rates. Sections 4.1 through 4.5 address systems with an MRS; Section 4.6 addresses the same systems without an MRS.

4.1 RADIOLOGICAL ROUTINE EXPOSURES

Radiological routine exposures were calculated using the RADTRAN 4 computer code as described above. Each SNF cask is designed to exactly comply with the maximum permissible regulatory criteria routine radiation exposures. This includes radiation at the cask surface and at 2 meters from the cask when loaded with the design basis SNF. Actual exposures based on average cask contents (number of assemblies, radiological inventory) are estimated to be about one-half of the regulatory exposures (see Appendix B). Routine public and occupational radiation exposures are displayed in Table 4-1.

All systems use rail at 85% of the facilities and trucks at the remaining 15%. Because the transportation modes and cask capacities are effectively the same for all systems (see Reference 55), the total number of cask shipment-miles are essentially the same.

Table 4-1. Transportation Radiological Routine Exposures (total program)

Mode	Routine Exposure (person-rem)		
	Occupational	Public	
Rail, barge, and heavy haul	50	340	
• Trucks	720	340	
Total program	1,450		

4.2 RADIOLOGICAL INCIDENT EXPOSURES

If an incident occurs, the cask damage severity can range from no damage to the release of radioactive particulates and gases. The severity probability distributions are derived from a study

of nationwide accidents of vehicles, similar to those planned for this program. See Reference 9. This analysis uses the severity data listed for each transportation mode in Appendix B.

Radiological incident exposures are calculated using the RADTRAN 4 computer code with information from Reference 10, and assumptions described above. The DOT highway offices and the Federal Rail Administration (FRA) report (Reference 64) identify the statistical probability of accidents. References 51 and 64 screened the data for statistics of similar vehicles under comparable conditions. Radiological impacts and exposures during empty cask shipments to the utility sites are negligible. The accident probabilities used in the RADTRAN estimates were derived from References 51 and 64.

The RADTRAN computer code estimates, for incidents, use appropriate isotopic distribution of the material released. Lists of the isotopes are provided in Appendix C. The isotope inventories contribute over 99% of the health hazard of the spent fuel, Reference 48 (RADTRAN 4 User Guide, pp. 5-23).

Total expected-person-rem exposure from incidents is summarized in Table 4-2. Estimates assume the isotope distribution for a nominal design basis PWR SNF described in Appendix C and Reference 72. Isotope inventories are listed in Appendix B.

RADTRAN calculations indicate no expected early fatalities from radiological releases. Expected-person-rem for the program are essentially the same for all systems. Use of truck transport always leads to higher incident exposures because of the larger number of casks required to ship equal amounts of SNF. Rail shipment exposures include any associated off-site heavy-haul or barge use. The total of rail plus barge and heavy-haul exposures on any route is always less than the corresponding expected person-rem for the use of trucks alone.

Table 4-2. Expected Population Exposure for Transportation Incidents (total program)

Mode	Expected Exposure (person-rem)
Dedicated Unit Trains, Barge and Heavy-haul	420
• Trucks	10
Total program	430

The systems uses rail at 85% of the sites and truck at the remaining 15%. If all sites use rail there will be a reduction in the total exposure from incidents. As with routine exposure, shipping truck casks on rail-cars will also reduce the exposures, since the expected frequency of accidents and the severity are reduced.

4.3 NON-RADIOLOGICAL ROUTINE IMPACTS

Transportation health and safety routine effects will occur from vehicular emissions. Non-radiological health and safety effects to the public and occupational workers are computed

together. The non-radiological effects are essentially the same for all systems since they have identical transportation modes and effectively the same cask capacities.

Engine exhaust is the major source of toxic, and potentially carcinogenic, pollution during transportation. The total emission weights, based on the data of Reference 43, are summarized in Table 4-3.

Table 4-3. Non-Radiological Routine Emissions During Transportation (two-way travel, program total)

Products (tons)	Trucks	Dedicated unit trains
Particulates	40	510
Sulfur oxides	250	1,130
Nitrogen oxides	630	7,380
Hydrocarbon vapors	160	2,160
Traction rubber (tires)	30	na
Total Program	1,110	11,180 12,290

The health-related emissions include airborne hydrocarbon combustion particulates, sulfur oxides, nitrogen oxides, and hydrocarbon vapors that are either toxic or potentially carcinogenic. Pollution emissions accumulate during 40 years of operations, with over 16,000 cask shipments, and at least 80 million miles of travel. The estimates are conservative by at least 2 times and conservatively assume that the transportation pollution control technologies remain at 1982 efficiency levels. It is assumed that the emission rates of the prime mover engines, per mile traveled, are independent of the road conditions and whether the SNF containers are loaded.

4.4 NON-RADIOLOGICAL INCIDENT IMPACTS

Estimates of the injuries and fatalities from CRWMS transportation operations are provided in Table 4-4. The data are based on information from References 51 and 64, and extremely conservative assumptions. Barge and heavy-haul values are extremely small and are included with the dedicated train totals, since they are used together exclusively.

Table 4-4. Non-Radiological Public and Occupational Injuries and Fatalities (program total)

Trucks (HM-164 Highways)		Dedicated Unit Trains
• Injuries	10	120
Fatalities	1	29

All estimates are based on two-way travel, with empty casks to the utilities and loaded casks to the MRS and MGDS. Dedicated rail is always used between the MRS and the MGDS. These injuries and fatalities are accumulated during the total system operations, with over 16,000 cask shipments and at least 80 million miles. The estimates assume that the transportation safety accident rates remain fixed at the early 1990s levels. Non-radiological routine impacts are effectively the same for all systems.

For comparison, total transportation fatalities for large trucks in the U.S. over the same 40-year period as the CRWMS program (about 29 years for an MRS) are estimated to be 190,000 fatalities (190,000 times the number of truck fatalities estimated for the CRWMS). Similarly, for comparison, total rail transportation fatalities over the same 40-year period are estimated to be 44,000 fatalities, which even with the extremely conservative assumptions used to develop the rail results for this report, is 1,600 times the number of rail fatalities estimated for the CRWMS.

4.5 GENERAL FREIGHT RAIL SHIPMENTS

Dedicated unit trains are evaluated as the basis for this report, since special ALARA and operating procedures could be used to reduce routine radiological exposures. However, a potentially lower cost alternative to the use of dedicated unit trains for all loaded cask shipments is the use of general manifest freight shipments from the utilities to the MRS or from utilities to the MGDS. For general freight use from utilities, a set of 3 empty or unloaded cask cars are shipped to a utility, and the other cars of the general freight train continue onward to other shippers. At a later time a rail carrier locomotive will connect to the loaded 3-car block from the utility and ship the casks to the destination in accordance with general commercial rail routing and handling practices. This means that a cask car block can be removed from the general train for classification and routing at switchyards enroute, and delayed by the rail carrier when necessary to make connections. (In contrast, dedicated unit trains from the MRS, with 3 cask cars per train, are preceded by general freight shipment of the empty casks to the utilities.)

General freight trains may carry any number of cask cars. For general freight trains, all conventional commercial railroad practices are assumed to apply. General freight shipment evaluations herein use DOT statistics that include all accidents, injuries, and fatalities, with all railroad equipment (including passenger trains) under all conditions on all classes of rail lines (including switchyards). The DOT national average data (for 1992) indicate that typically only 1.03 hazardous material cars on average were damaged in each accident to a train containing hazardous materials. These evaluations assume that these DOT statistics apply to shipment of SNF casks.

General freight, in contrast to dedicated trains, moves at greater speeds in rural areas, receive more delays through switchyards, and inspections can be performed frequently and slowly. Delays in switchyards and sidings while awaiting pickup and delivery are expected to be longer for general freight than for dedicated unit trains. Railroad workers are in close proximity to the casks in switchyards and on sidings while performing duties on adjacent unrelated cars and the cask cars. Roughly half of the reported injuries, although few of the fatalities occur in switchyards. However, the statistical allocation of injuries, and fatalities on a pro-rata basis per car of each general freight train means a considerable reduction in the estimated fatalities and

injuries. Comparisons of health and safety impacts for general freight versus the analysis baseline dedicated freight shipments are presented in Table 4-5, at the program level.

Table 4-5. Comparison of Health and Safety Impacts for General vs. Dedicated Freight

	General freight for loaded casks shipped to MRS and dedicated freight from MRS to MGDs	Dedicated freight baseline of all loaded casks to MRS and from MRS to MGDS
Radiological		
Routine, person-rem occupational public Total	1,360 <u>990</u> 2,350	770 <u>680</u> 1,450
Incidents, expected-person-rem	40	430
Total Exposure, person-rem	2,390	1,880
Non-Radiological		
Routine, emission - tons	12,290	12,290
Incidents injuries fatalities	128 15	132 30

4.6 TRANSPORTATION HEALTH AND SAFETY IMPACTS FOR NO MRS SYSTEM (DIRECT SHIPMENT)

An alternative is the use of direct shipments from the utilities to the MGDS. A set of 3 empty or unloaded cask cars would be shipped to a utility. At a later time a rail carrier locomotive will connect to the loaded 3-car block from the utility and ship the casks to the destination in accordance with commercial rail routing and handling practices. Direct shipment to a MGDS reduces all of the impacts on the environment, health and safety. Marshalling the rail-cars to increase the numbers of cask cars per train from 3 to 6 would reduce the incident exposures, injuries, and fatalities about 50% if the total cask-car mileage remained the same, as could be done most simply by using 6 cask-car shipping campaigns.

Health and safety impacts at the program level for direct shipments of all loaded casks are presented in Table 4-6.

Table 4-6. Transportation Health and Safety Impacts for No MRS System (Direct shipment)

	Direct Shipment of all loaded casks to MGDS (no MRS)
Radiological	
Routine, person-rem occupational public Total Incidents, expected-person-rem	770 <u>660</u> 1,430 410
Total Exposure, person-rem	1,840
Non-Radiological	
Routine, emission - tons	9,440
Incidents injuries fatalities	90 22

4.7 PUBLIC EXPOSURE TO RADIATION FROM SNF TRANSPORT

Public exposure will take place enroute (sometimes within a few feet during gridlock in urban areas), at enroute stops, or from roadside and railside positions. The roadside and railside (between truck stops and rail yards) public exposure per mile, are essentially the same for rail and HM-164 highway routes. However, the number of people exposed at close range while on the highways is markedly larger for truck transportation than for rail. The relative enroute traveler exposures, based on the standard default values of RADTRAN 4, Reference 48, are displayed in Table 4-7. The numbers presented in this table are the number of people on the highways and railroads within 800 meters of a shipping cask. Heavy-haul comparable data are not available from Reference 49 nor from other sources.

In urban areas, the margin of truck over rail, for number of people receiving at least some exposure, is about 600:1. In suburban areas, the margin drops to about 150:1, and in rural areas the margin is about 500:1. Barges, used to reach rail-transfer points with large rail casks, will create essentially zero exposure to enroute travelers. However, actual routes are mostly in rural areas, and rarely in the cities, so a more realistic estimate should reflect that situation. Actual trip routes on a national average contain about 1% urban travel, about 19% suburban, and 80% rural. Weighing exposures by these percentages will define a "unit trip." During each "unit trip" the normalized exposure will be about 560 people per truck, compared to two people per train. Further, since large rail casks contain about 4.5 times more MTUs than truck casks, there will be fewer rail trips per MTU disposed. Thus the cumulative enroute exposure ratio of truck shipments compared to rail is about 1000:1.

Table 4-7. Relative Numbers of Public Receiving Radiation Exposure During Travel on Highways and Railroads

	Truck	Rail
Travelers per hour, one way, on the route: • Urban	2800	5
Suburban	780	5
Rural	470	1
Normalized to a Unit Trip	560	1.8
Trips per MTU Ratio (truck casks are smaller)	4.5	1
Normalized Unit Trip Multiplied by MTU per Trip Ratio	2,520	1.8

5. SUMMARY AND CONCLUSIONS

5.1 SUMMARY

This report evaluates the health and safety impacts of a CRWMS that uses the MPC in comparison with three other alternative systems.

The MPC system relies on the use of a clean, sealed, metal canister for all CRWMS operations including storage, transportation, and disposal. Other alternative systems being evaluated are the reference scenario, a dual purpose cask system: the TSC system, and a multi-purpose cask system: the MPU system.

Impacts to public and to occupational health and safety are evaluated. Radiological and non-radiological impacts caused by routine (day-to-day) activities and incidents (accidents) are included. Radiological impacts are measured by the radiological exposure received by persons and non-radiological impacts are measured by fatalities, injuries, and the emission of non-radioactive toxic materials. Health and safety impacts at facilities and during transportation are evaluated separately. Facilities include utilities and other SNF storage sites (called utilities herein), the MRS facility, the CMF, and the MGDS. Systems are evaluated both with and without an MRS. Health and safety impacts at the utilities, the MRS, and the MGDS are computed from impacts caused by handling spent nuclear fuel (SNF) and SNF casks. The MGDS also includes impacts caused by the handling of vitrified HLW canisters and waste packages. Impacts associated with the CMF result from routine maintenance of contaminated casks. Transportation impacts result from the shipping of both loaded and unloaded SNF casks between facilities. Health and safety impacts are addressed in four areas:

•	Radiological Routine Exposures -	Includes radiation exposure during routine facility operations and during transportation.
•	Radiological Incident Exposures -	Includes radiation exposure from incidents involving SNF fuel, HLW, and cask/canister handling, and transportation.
•	Non-Radiological Routine Impacts -	Includes routine non-radioactive toxic effluents from facilities and during transportation.
•	Non-Radiological Incident Impacts -	Includes non-radiation-related incidents at

facilities and during transportation.

Table 5-1 illustrates the total system health and safety impacts for both radiological exposure and non-radiological impacts caused by routine activities and incidents. Note that all health and safety impacts are equivalent for any of the four alternative systems with the exception of atfacility routine radiological exposures. Routine radiological exposures result in 99.6% of all exposures, with incidents contributing to about 0.4% for any of the alternative systems.

Table 5-1. Total System Health and Safety Impacts (total program, with MRS)

System Impact Area	Single Purpose Cask System (Reference)	Dual Purpose Cask System (TSC)	Multi-purpose Cask System (MPU)	Multi-purpose Canister System (MPC)
Radiological Routine (person-rem)				
Facilities	42,080	43,820	53,920	56,980
Transportation	1,450	1,450	1,450	1,450
Radiological Incident (person-rem)				
• Facilities ^b	0.10	0.08	0.04	0.04
Transportation*	430	430	430	430
Non-Radiological Routine (emissions)				
• Facilities ^{be}	.1 tons	.1 tons	.1 tons	.1 tons
Transportation**	12,290 tons	12,290 tons	12,290 tons	12,290 tons
Non-Radiological Incidents (injuries and fatalities)				
 Facilities injuries fatalities 	470 4	470 4	470 .4	470 4
 Transportation^a injuries fatalities 	132 30	132 30	132 30	132 30

- Notes: a) Values shown are for all truck, rail, barge, and heavy-haul.
 - b) Systems approximately the same; within regulatory limits.
 - c) Includes particulates, sulphur and mitrogen oxides, and hydrocarbon vapors that are toxic or potential carcinogens.

Effectively all of the facility radiological exposures are incurred by occupational workers in the nuclear/waste management industries. As can be seen in Table 5-1, the at-facility routine radiological exposures are approximately 35% higher for the MPC system than for the reference scenario (56,980 versus 42,080 person-rem). These higher exposures are caused primarily by the MPC welding operations at the utilities and at the MRS. Welding associated operations at these facilities alone contribute to about 80% (12,600 person-rem) of the difference between the MPC system and reference scenario exposures. The dominant impact of a single operation, welding, suggests that the use of automated canister sealing operations or other techniques could significantly lower the MPC and MPU system exposures to be effectively equivalent to those of the reference system.

Table 5-2. Total System Radiological Routine Impacts (person-rem)

	Single Purpose Cask System (Reference)	Dual Purpose Cask System (TSC)	Multi-purpose Cask System (MPU)	Multi-purpose Canister System (MPC)
Facilities: • Utilities	13,110	14,550	25,880	25,660
• MRS	8,200	6,140	7,420	10,700
• CMF	160	140	60	60
• MGDS	20,610	22,990	20,560	20,560
Total	42,080	43,820	53,920	56,980
Transport: Occupational	770	770	770	770
Public	680	680	680	680
Total	1,450	1,450	1,450	1,450
Program Total	43,530	45,270	55,370	58,430

Table 5-2 illustrates how routine radiological exposures are distributed among the facilities and transportation. The radiological exposures at the utilities are significantly higher for the MPC system than for the reference scenario (26,000 versus 13,000 person-rem). This is dominated by the welding operations that contribute 11,500 of the 13,000 person-rem difference. Though not as significant, welding operations at the MRS (1,100 person-rem) have a large impact on the higher MPC system exposures.

The MGDS exposures caused by the reference system, MPU and MPC systems are about the same and lower than those caused by the TSC system. Because of an additional bolted lid that must be removed while unloading a TSC, the TSC system produces higher exposures at the MGDS than the other alternative systems. The CMF exposures are small for all systems.

Transportation exposures are equal for all systems. Public exposure is the same for all of the alternative systems and makes up less than 2% of the total system exposure.

Changes with no MRS in all of the alternative systems were also evaluated. With no MRS there will be more interim storage at some utilities, followed by direct shipment to a MGDS. Table 5-3 contains the values with an MRS, and with no MRS. The facility radiological incident exposures, nonradiological emissions, injuries and fatalities did not change significantly. There were from 5% less for the reference scenario, to 15% less for the MPC of routine radiological exposures at facilities. Without an MRS, the TSC system facility exposure is below that of the reference scenario. Transportation had 23% less nonradiological emission, 25% fewer fatalities, and 32% fewer injuries with no MRS.

Table 5-3. With-MRS/No-MRS Total System Health and Safety Impacts (total program)

System Impact Area	Single Purpose Cask System (Reference)	Dual Purpose Cask System (TSC)	Multi-purpose Cask System (MPU)	Multi-purpose Canister System (MPC)
Radiological Routine (person-rem)				
Facilities	42,080/40,150	43,820/37,510	53,920/50,700	56,980/50,860
Transportation*	1,450/1,430	1,450/1,430	1,450/1,430	1,450/1,430
Radiological Incident (person-rem)		-	•	
Facilities ^b	0.10	0.08	0.04	0.04
Transportation	430/410	430/410	430/410	430/410
Non-Radiological Routine (emissions)				
• Facilities ^{b.c}	.1 tons	.1 tons	.1 tons	.1 tons
Transportation**	12,290/9,440 tons	12,290/9,440 tons	12,290/9,440 tons	12,290/9,440 tons
Non-Radiological Incidents (injuries and fatalities)				
Facilities injuries fatalities	470 4	470 4	470 4	470 4
 Transportation injuries fatalities 	132/90 30/22	132/90 30/22	132/90 30/22	132/90 30/22

Notes: a) Values shown are for all truck, rail, barge, and heavy-haul.

b) Systems approximately the same; within regulatory limits.
c) Particulates, sulphur and nitrogen oxides, and hydrocarbon vapors that are toxic or potential carcinogens.

5.2 CONCLUSIONS

Table 5-1 shows that all health and safety impacts are effectively equivalent for any of the four alternative systems with the exception of routine radiological exposures at facilities. Effectively all of the facility radiological exposures are incurred by workers in the nuclear waste management industries.

As can be seen in Table 5-1, the total routine radiological exposures at facilities are 35% higher for the MPC system than for the reference scenario (57,000 versus 42,000 person-rem). These higher exposures are dominated by the MPC welding operations at the utilities and at the MRS. Welding operations at these facilities alone contribute about 85% (12,600 person-rem) of the difference between the MPC and reference scenario exposures. Total exposures are small relative to expected background radiation exposures (e.g., natural sources, medical uses, radon, etc.) to the U.S. population of 3.5 billion person-rem over the same period of time as the CRWMS program.

Table 5-2 shows that the radiological exposures at the utilities are almost 2 times higher for the MPC system than for the reference technology (25,700 versus 13,100 person-rem). The MPC at-utility exposures again are dominated by welding operations that contribute to 70% (11,500 out of 13,000) of the person-rem difference.

The majority of the increased exposure caused by the MPC system is related to one operation: canister welding. The reference system, on the other hand, is not dominated by a single source or activity so there is no specific opportunity for significant exposure reduction. This strongly suggests that the application of automated canister sealing operations or other techniques could significantly lower the MPC system exposures to be effectively equivalent to those of the reference scenario.

Table 5-3 indicates that with no MRS the evaluated system health and safety impacts will decrease or remain the same for all of the alternative systems. The magnitude of the results for the systems without an MRS are similar to those with an MRS (e.g., for MPC system; 50,860 person-rem with MRS and 56,970 person-rem without an MRS). The facility health and safety impacts for systems without an MRS are higher for the MPC system than for the reference scenario, and the same trend exists for the systems with an MRS.

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APPENDIX A FACILITY ROUTINE RADIATION EXPOSURES

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AL FACILITY ROUTINE RADIATION EXPOSURES EVALUATION

This portion of Appendix A provides flow charts and copies of the key spreadsheets used to evaluate the routine radiation exposures at each of the CRWMS facilities (utilities, MRS, and MGDS) for four designs (reference scenario, the TSC, the MPU, and the MPC system designs). These are based on MPC facility routine exposure calculations that are described in Section A2. In this section, the radiation exposures for the each system are made consistent within each CRWMS facility. The facility radiation exposure estimates in Section A2 and the spreadsheets were based on nuclear utility operations experience and data from Electric Power Research Institute (EPRI) reports. This exposure data, along with the definitions of operations, are then used to create the detailed exposures spreadsheets for the alternative CRWMS designs, including the reference scenario, TSC, MPU, and MPC system. This process includes organizing and harmonizing of the input data to create a consistent basis among all four alternatives. Consistent conservatism was maintained among the alternatives by using the same dose rates versus distance for each, comparable staffs, and comparable exposure times for each step. The level of conservatism is potentially more than two times.

The calculations for this report, as shown in the first section of this Appendix, are based on the nominal exposure values and times. The estimates do not assume the use of As Low As is Reasonably Achievable (ALARA) techniques. In Section A2 are examples of what can be achieved to reduce exposures by the use of ALARA techniques.

The empirical data on which these calculations are based on dose rates measured during comparable operations with comparable casks under conditions similar to those expected in the reference scenario and the MPC systems. Conservative values are obtained since these data describe the handling times for the first casks and canisters in the program. Learning curve experience can provide significant reductions in the exposures per operation, in view of the many thousands of repetitive operations, especially at the MRS and MGDS, in the forty-year program life cycle.

Figures A1-1, A1-2, A1-3, and A1-4 describe the exposures, numbers of cask/canisters handled, and the resulting exposures for each major step at CRWMS facilities. Each arrow represents a cask/canister handling. The quantities adjacent to these arrows are the exposure rates, the number of casks/canisters, and total exposures. The dashed arrows without quantities designate transportation, which is dealt with in Appendixes B and C.

Detailed spreadsheets used in estimating the routine radiological exposures for each of the CRWMS system designs at each facility are provided in Table A1-1 and those following. These tables are based on the detailed technical information and logistics data of References 55, and 57, of the body of this report. Those reports should be consulted for the definitive descriptions of each of the cask, canister, and handling requirements of the alternative systems.

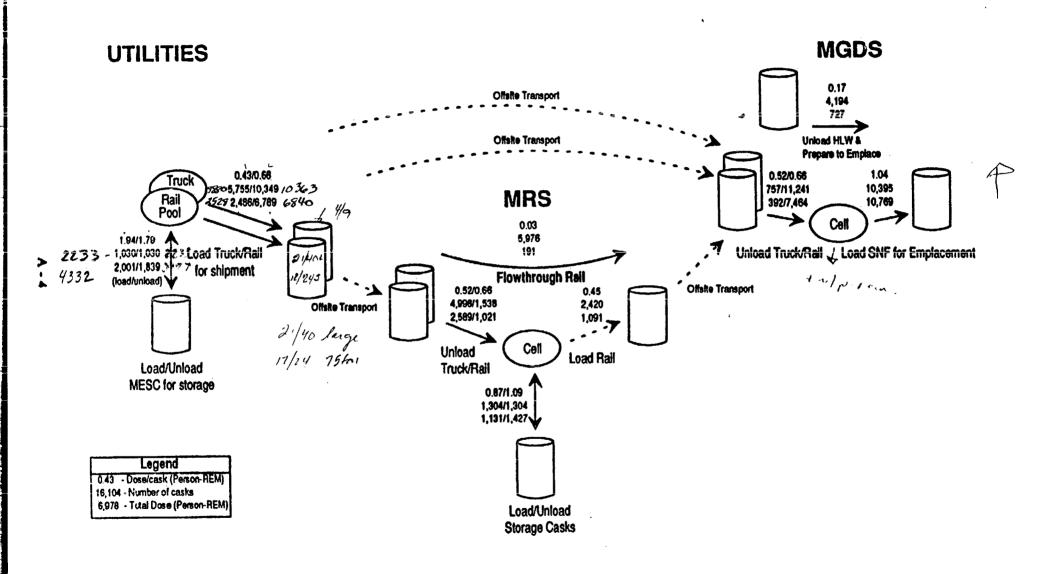


Figure A1.1. Single-Purpose System Occupational Routine Radiological Exposure-Primary Operations for SNF

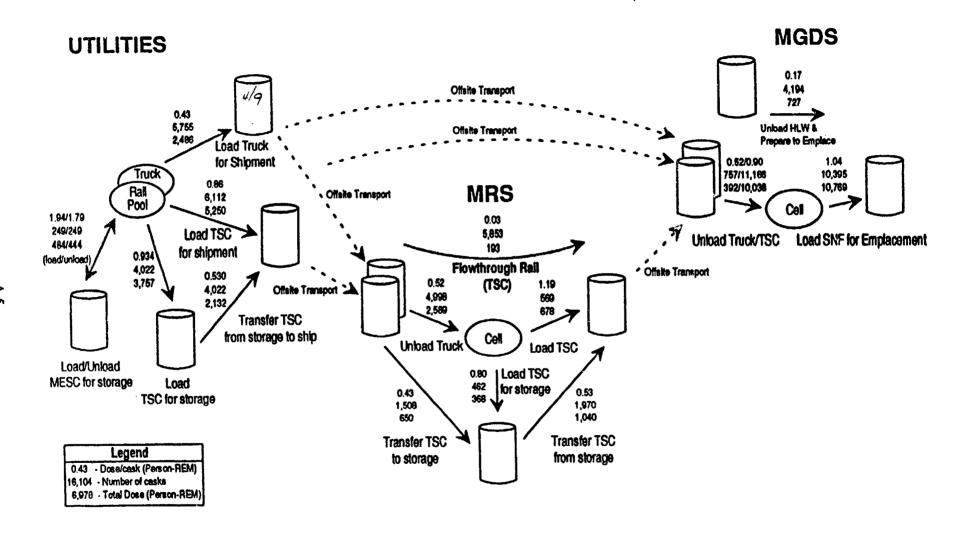


Figure A1.2. TSC System-Routine Occupational Radiation Exposure

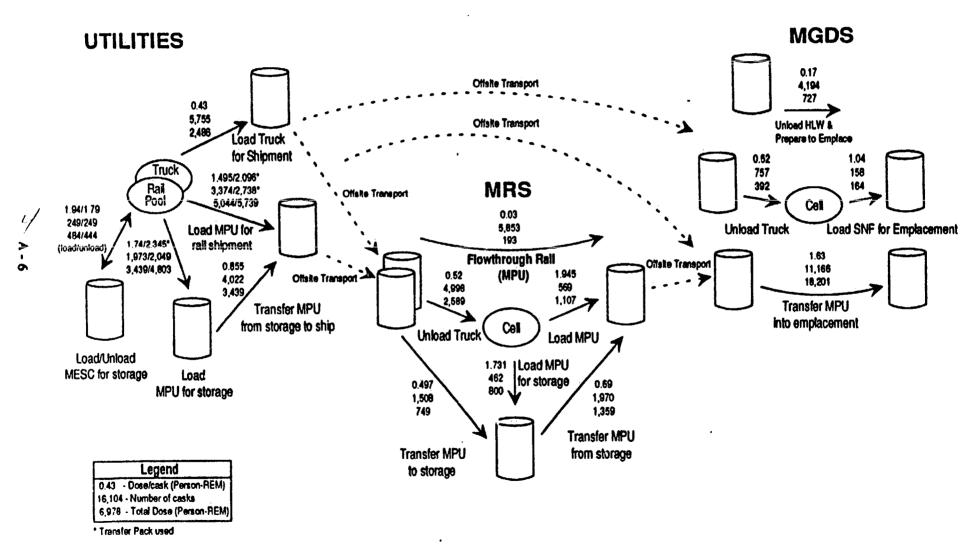


Figure A1.3. MPU System-Routine Occupational Radiation Exposure

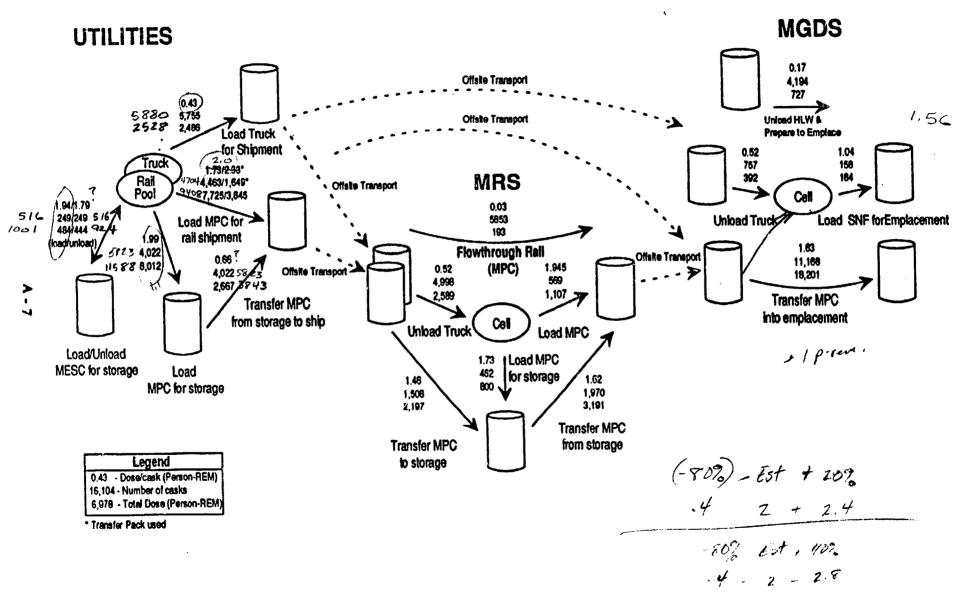


Figure A1.4. MPC System-Routine Occupational Radiation Exposure

Table A1-1 through A1-4. SNF Storage Sites

Table A1-1. Utilities-Reference

tal Doses per Cask Handling for SPS of the Utilities				-	ruck & Roll mrem/hr	-	Bocks		
			L		ld doest	****	LIA OLU		\vdash \dashv
	Drect		am	_	Ther .	_	Grane		
ad for Shipping		D-MAN	}		p/fx conkild		decor		
tece (1,2,3a,4a,5) Truck for at : SPS, TSC, MPU, MPC	349		45	4.	ateral Sidn		pool	3	
tope (1,2,3b,4b,5b) Rail for SPs only.	533	122	-00	익는	Crerca son		579	2	$\vdash \vdash \vdash$
			!		torage cask mrem/tr		-		
	ļ	-		_	id doses	220	TELS.	. 0	
	1	<u> </u>		_	ner	97	-		
ad MESC: Steps-(6.7.8.9.10,11,12,13)	1,820				ruler	70	 		
rioad MESC: Steps-(14,15,16,17,18)	1,650	135	1.75		ip/ix cosklid oteral Sidn	70		 	
	 	 		+	CHECK SUIT		!	!	귤
	reter Transfeller)	es (met)		Personnel Regulated (Persons/1000)	Occupation	Working Distance (Feet)	Cosk Dose Rate(Invernity)	Dose (scraved/Person-mem)	Foolity dose background (personmens)
Cask Handling Operations	<u> </u>			7	assume arane area bo	_		1	
. Receive Unloaded Transportation Cask	 	3 10	<u> </u>		Operator); [) <u>ac</u>	0.0
hapect Bills of Loding, Other Shipping Popers	+ 1				Prime Mover Operator			_	
b. Release Off-Site Prime Mover (PM)	1 10				Pitme Mover Operator		5) (0.0	
. Hitch On-Site Prime Mover	1 2		_		Radiation Protection) IS	0.0	
Perform Receipt HP Survey	7 2				Prima Mover Operator	l k		0.0	
. Move Cask to Protected Area Gate	3				Security Officers	- 2		0.0	
Security Inspection			5		Operator). (0.0	
, Open Prep Area Door	3				Prime Mover Operator	Ľ	5 (0.0	
. Move Cask to Prep Area	1 5				Operators	1	2: (0.0	
Remove Personnel Barrier/Impact Limiters	 '	* 			Crane Operator	. 2). (0.0	
	+		5		Operator		D: (0.0	
Close Prep Area Door			ō	2	Operators	; ;		0.0	
c Remove Coak Restraints			ō	2	Radiation Protection			0 0.1	
Perform Prefirminary HP Survey			5		Operators			0 0.0	
m. Engage Yake to Cask	1		5	1	Rogman	1 34		0 0.0	
	1	1	5	1	Crane Operator	<u>: 2</u>		0 0.0	
14 Carlotte Dans Amo	3	0 3	0		Operators	_		0.0	
n, Uff Cosk Into Prep Area	1	3	0	1	Crane Operator	. 2	<u> </u>	0 0.0	
Exic	34	\$ 51	5			<u>: -</u>		0.1	24
/314									┼
2. Prep Transportation Case for loading in Pool					casume pod area	_		rem/tr	
a. Install Shield Platform	3	0 3	0		Operator	_		0.	_
b. Attach Gas Sampling/Vent Equipment		5	5		Operator			0 0	
c. Sample Gas Cavity	- 2	0	0		Operator				
d. Vent Calk Cavity			0		Operator			-	
e. RE Cosk with Woter		9	- 19		Operators	; -		0 0	
f. Remove Sampling/Venting Equipment		5	5		Operator	+-		0 0	_
g. Leosen Cask Ud Bolls			20		Operators			0 0	
h. Attach Lid Sing to Cask Yoles			10		Operator	_		0 0	
			10		Ragman			0 0	
			10		Crane Operator	+-		ol a	
L Install Contamination Protection on Calk			30		Operators	+-	6:		0 1.5
L Remove Shield Plotform			30		Operator Operators	+ ,	10		0 20
k. Lift Cask onto Pool Platform			20		Crane Operator		20'		0 1.0
			20 30		2 Operators	1	2:		0 3.0
I. Remove Remaining Ltd Botts			30		Operators	7	30		0 3.0
m. Uit Cask to Pool Bottom	- - '		30		Crane Operator		40	0 0	0 1.
		10	10		Operator	_	30	0 0	0.0
n. Disengage Yake		 -	10		1 Ragman		30	0 0	0 0.
	 -		10		1 Crane Operator		40		0 0
10-1146 0-cl	-+	20	20		Operator		2:		.0 1.0
o. Remove Yoke and Cask Lid from Pool	-	 	20		1 Rogman		10	0 0	.0 1.0
		-	20		1 Crane Operator	į i	20	0 0	.0 1.0
					+			1 0	.0 34.1
		40	toni						
Total	13	60 4	190				;		\mathbb{I}_{-}
		60 4	190	_	ON The Cool (780		<u> </u>	-	-
Total 3a. Load SNF into Truck Transportation Cask a. Attach SNF Grapple to Crane	-	10	10	_	cassume pool crea			0.5	12 1,

Table A1-1. Utilities-Reference (continued)

b1. Time for cosk	50	50		Operator	20:	0.5	0.8	5
Load SNF into Transfer Cask	70	70	2	Operator	20	0.5	1.2	7
Total	130	130					2.2	13
b. Load SNF into Rail Transportation Cask				assume pool area				
SNF Grappie Attrached to Crane	10	10	2	Operators	20.	0.5	0.2	_1
Engage One SNF Assembly, (12 min. per assembly)								
b1. Time for crark	250	2:0	2	Operators	20.	0.5	4.2	25
Load SNF Into calk	70	o		Operators	20	0.5	1.2	7.
	330	330			-		5.5	33
Total						-+		
				casume pool area back	~~~	1		
a. Prop Truck Transportation Cask from Pool			 ,			0	0.0	O
a. Impect Cask Seal	10	10		Operator	30	0	0.0	2
b. Place Cask (id and Engage Yoke	25	ిన		Operators		_		
		:ద		Roomon	30	0	0.0	_ !
		<u> </u>		Crane Operator	40	0	0.0	1
c. Lift Cask to Pool Surface	10	10		Operators	10:	0	0.0	1
		10		Crane Operator	20	0	0.0	0
ct. Install Two Coale Ltd Bolts	5	5	1	Operator	2.	60	5.0	_0
e. Lift Cask into Prep/Decon Area	20	20	2	Operators	10	1.8	1.2	2
		105;	1	Crane Operator	20	0.5	0.2	_1
1. Decontaminate Yoke and Cask	45	45		Operator	10	8.7	6.5	2
PANCHELL PARTY OF COLUMN		15		Crane Operator	20	0.5	0.4	2
g. Disengage Value and Lid Sing from Cask	10	10		Operator	21	17	28	0
A residence tone distributed in contract		10		Ragman	10	8.7	1.5	
		10		Crane Operator	20	0.5	0.11	0
	5	5		Operator	2	60	5.0	_
h. Attach Vers and Drain Lines				Operator	2	17	5.7	Ť
L Drain Coak	- 60				2:	43	28.7	
j. HP Survey	45	20		Radiation Protection				- 5
k. Secure Cask Bolled Ltd	30	30		Operators	<u>_2</u> _	- 60	60.0	3
L Connect Drying and Inerting Equipment	10	10		Operator			10.0	
m. Drain, Dry, and thert Cask	90	90		Operator		17	25.5	4
		90		Operator	10	8.7	13.1	_4
n. Remove Drain, Drying, and inerting Equipmen	10	10	1	Operator	2	60	10.0	0
o. Perform Leick Test on Sect	10	10	1	Operator	5.	17	2.8	0
Total	385	555		1			178.4	33
	1					\neg		
b. Prep Rail Transportation Cask from Pool (times are	-	by day	-				cool cre	_
D. Prep and interpolitation cost, some root (asine as				70700 TO ROSE (FORT) 412.49	1.4.7	71	<i>-</i>	
	201	20	1	Coercies	1.8.>			
2. Inspect Cask Sect (s)	20	20	1	Operator	2	Ol	0.0	
2. Inspect Cask Sect (s)	20 25	<u>20</u> 25	1	Operators	2 30	0	0.0 0.0	1
2. Inspect Cask Sect (s)	20	<u>න</u> න න	1 2 1	Operators Ragman	2 30 30	0	0.0 0.0 0.0	- 1
a. Inspect Cask Seal (g) a. Place Cask Lid and Engage Yoke	20 25	20 20 20 20 20 20 20 20 20 20 20 20 20 2	1	Operator Operators Rogman Crane Operator	2 30 30 40	0 0 0	0.0 0.0 0.0 0.0	2
a. Imprect Cask Seal (s) a. Place Cask Lid and Engage Yoke	20	න න න න	1 2 1	Operator Operators Ragman Crane Operator Operators	30 30 40 10	0 0 0	0.0 0.0 0.0 0.0 0.0	
a. Imprect Cask Seal (s) a. Place Cask Lid and Engage Yoke	20 25 10	20 25 25 10 10	1 2 1 1 2	Operator Operators Ragman Crane Operator Operators Crane Operator	2 30 30 40 10 20	0) 0) 0) 0)	0.0 0.0 0.0 0.0 0.0	-
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke c. Lift Cask to Pool Surface	20 25 10	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	1 1 1	Operator Operators Flagman Crane Operator Operators Crane Operator Operator	2 30 30 40 10 20 2	0) 0) 0) 0) 0)	0.0 0.0 0.0 0.0 0.0 0.0 5.0	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface 1. Install Two Cask Lid Botts	20 25 10	20 20 20 20 20 20 20 20 20 20 20 20 20 2	1 2 1 1 2 2	Operator Operators Ragman Crane Operator Operators Crane Operator Operator Operator Operator	2 30 30 40 10 20 2	01 01 01 01 01 01 01 01	0.0 0.0 0.0 0.0 0.0 0.0 5.0	
a. Impact Cask Seal (s) a. Place Cask Lid and Engage Yoke E Lift Cask to Pool Surface 1. Install Two Cask Lid Bolts	20 25 10	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	1 2 1 1 2 2	Operator Operators Flagman Crane Operator Operators Crane Operator Operator	2 30 30 40 10 20 2 10	01 0 0 0 0 0 0 0 1.8	0.0 0.0 0.0 0.0 0.0 0.0 5.0 1.2	
a. Impact Cask Seal (s) a. Place Cask Lid and Engage Yoke E. Lift Cask to Pool Surface d. Install Two Cask Lid Botts a. Lift Cask into Prep/Decon Area	20 25 10	20 20 20 20 20 20 20 20 20 20 20 20 20 2	1 2 1 1 2 1 1	Operator Operators Ragman Crane Operator Operators Crane Operator Operator Operator Operator	2 30 30 40 10 20 2	01 01 01 01 01 01 01 01	0.0 0.0 0.0 0.0 0.0 0.0 5.0	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface J. Install Two Cask Lid Botts a. Lift Cask not Prep/Decon Area Decontamnate	20 25 10 5 20	20 25 25 10 10 5 20 20	1 2 1 1 2 1 1 2 1	Operators Ragman Crane Operator Operators Crane Operator Operator Operator Operator Operator Operator Crane Operator	2 30 30 40 10 20 2 10	01 0 0 0 0 0 0 0 1.8	0.0 0.0 0.0 0.0 0.0 0.0 5.0 1.2	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke c. Lift Cask to Pool Surface d. Install Two Cask Lid Bots b. Lift Cask rate Prep/Decon Area Deconformable Yoke and Cask (s)	20 25 10 5 20	20 25 25 10 10 5 20 20 80 80	1 2 2 1 1 1 1	Operators Operators Ragman Orans Operator Operators Operator	2 30 30 40 10 20 2 10 20 10	0i 0 0 0 0 0 0 60 1.8:	0.0 0.0 0.0 0.0 0.0 0.0 1.2 0.2	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke c. Lift Cask to Pool Surface d. Install Two Cask Lid Bots b. Lift Cask rate Prep/Decon Area Deconformable Yoke and Cask (s)	20 25 10 5 20	20 25 25 10 10 5 20 20 80 80	1 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Operator Operators Ragman Crane Operator Operators Crane Operator	2 30 30 40 10 20 2 10 20	0i 0 0 0 0 0 0 0 80 1.8 0.5	0.0 0.0 0.0 0.0 0.0 0.0 5.0 1.2 0.2	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke c. Lift Cask to Pool Surface d. Install Two Cask Lid Bots b. Lift Cask rate Prep/Decon Area Deconformable Yoke and Cask (s)	20 25 10 5 20	20 25 25 10 10 5 20 20 80 80	1 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Operator Operators Ragman Crane Operator Operators Crane Operator Operator Operator Operator Operator Crane Operator	2 30 30 40 10 20 20 10 20 20 20 20 20	0i 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.0 0.0 0.0 0.0 0.0 0.0 0.0 1.2 0.2 11.6 0.7 2.8	
a. Impact Cask Seal (s) a. Place Cask Lid and Engage Yoke 2. Lift Cask to Pool Surface 3. Install Two Cask Lid Bolts a. Lift Cask into Prep/Decon Area Decontamnate Yoke and Cask (s) a. Deengage Yoke and Lid Sing from Cask	20 25 10 5 20 80	20 25 25 25 10 10 5 20 20 80 80 10	2 1 1 1 1 2 2 1 1	Operator Rogman Crane Operator Operators Crane Operator Operator Operator Operator Operator Operator Crane Operator	2 30 30 40 10 20 2 10 20 10 20 2 10 20 20 20 20 20 20 20 20 20 20 20 20 20	01 0 0 0 0 0 0 0 1.8: 0.5 8.7: 0.5 17: 8.7:	0.0 0.0 0.0 0.0 0.0 0.0 0.0 1.2 0.2 11.6 0.7 2.8 1.5	
a. Impact Cask Sedi (s) b. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface d. Install Two Cask Lid Botts b. Lift Cask into Prep/Decon Area Decontaminate Yoke and Cask (s) b. Disengage Yoke and Lid Sing from Cask Attach Vent and Drain Lines	200 255 10 55 200 800	20 25 25 10 10 5 20 20 80 80 10	2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Operator Operators Ragman Crane Operator Operators Crane Operator	2 30 30 40 10 20 2 10 20 10 20 2 10 20 2 2	0i 0 0 0 0 0 0 1.8: 0.5 8.7: 0.5 17: 8.7: 0.5:	0.0 0.0 0.0 0.0 0.0 0.0 0.0 5.0 1.2 1.2 1.6 0.7 2.8 1.5 0.1	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface d. Install Two Cask Lid Bolts a. Lift Cask into Prep/Decon Area Deconformate Yoke and Cask (s) a. Deengage Yoke and Lid Sing from Cask	200 255 100 55 200 800 100 55 110	20 25 25 10 10 5 20 20 80 80 10 10 10	22 1 1 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Operators Operators Ragman Orans Operator Operators Operators Operator Operators Operators Operators Operators Operators Operators Operator	2 30 30 40 10 20 2 10 20 20 10 20 2 10 20 2 2 2 2	01 0 0 0 0 0 0 1.8 0.5 8.7 0.5 17 8.7 0.5 17	0.0 0.0 0.0 0.0 0.0 0.0 5.0 1.2 0.7 2.8 1.5 0.1 5.0	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke E. Lift Cask to Pool Surface S. Install Two Cask Lid Bots b. Lift Cask nito Prep/Decon Area Deconformatie Yoke and Cask (s) b. Deengage Yoke and Lid Sing from Cask A. Attach Vent and Drain Lines Drain Cask(s) HP Survey(s)	200 255 100 55 200 800 100 55 1100 800	20 25 25 10 10 20 20 80 80 10 10 10 5 35	2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Operators Operators Ragman Orane Operator Operators Operators Operator	2 30 30 40 10 20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	01 0 0 0 0 0 0 1.8 0.5 8.7 0.5 17 8.7 0.5 17 43	0.0 0.0 0.0 0.0 0.0 0.0 1.2 0.2 11.6 0.7 2.8 1.5 0.1 5.0 9.9	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface install Two Cask Lid Botts Lift Cask into Prep/Decon Area Decontaminate Yoke and Cask (s) Descriptory Yoke (and Lid Sing from Cask Attach Veril and Drain Lines Drain Cask (s) C Secure Cask Bothid Lid(s)	200 255 100 50 200 100 55 1100 800 555	20 25 25 25 20 10 10 5 20 80 80 10 10 10 5 35 35	2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Operator Operators Ragman Orane Operator Operators Crane Operator Ragman Orane Operator Operator Operator Operator Operator Operator Operator	2 30 30 40 10 20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	01 01 01 01 01 02 05 0.5 0.5 0.5 17 0.5 0.5 17 0.5 17 0.5 17 0.5 17 0.5 17 0.5 17 0.5 18 17 0.5 18 18 18 18 18 18 18 18 18 18 18 18 18	0.0 0.0 0.0 0.0 0.0 0.0 0.0 1.2 0.7 2.8 1.5 0.7 2.8 1.5 0.7 2.8 1.5	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface install Two Cask Lid Botts Lift Cask into Prep/Decon Area Decontaminate Yoke and Cask (s) Descriptory Yoke (and Lid Sing from Cask Attach Veril and Drain Lines Drain Cask (s) C Secure Cask Bothid Lid(s)	200 255 100 55 200 800 100 55 1100 800	20 25 25 10 10 10 5 20 20 80 80 10 10 10 5 5 5 6 10		Operators Rogman Crane Operator Operators Crane Operator Rogman Orane Operator	2 30 30 40 10 20 2 10 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 00 00 00 00 00 00 1.8: 0.5 0.5 0.5 17: 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.0 0.0 0.0 0.0 0.0 0.0 1.2 0.2 11.2 0.7 2.8 1.5 0.1 5.0 9.9 9.9 5.0	
a. Impact Cask Seal (s) a. Place Cask Lid and Engage Yoke a. Lift Cask to Pool Surface d. Install Two Cask Lid Botts a. Lift Cask into Prep/Decon Area Decontaminate Yoke and Cask (s) a. Disengage Yoke and Lid Sting from Cask b. Attach Verif and Drain Lines Drain Cask(s) HP Survey(s) c. Secure Cask Botted Lid(s) Connect Drying and Inerling Equipment	200 255 100 50 200 100 55 1100 800 555	20 25 25 10 10 5 20 20 80 80 10 10 10 5 35 35 35 10		Operator Roperators Roperators Crans Operator Operators Crans Operator Operator Operator Operator Operator Operator Operator Coperator Operator Coperator Coperator Operator	2 30 30 40 10 20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 00 01 00 01 05 05 8.7 17 8.7 17 43 43 60 60 60	0.0 0.0 0.0 0.0 0.0 0.0 5.0 12.0 11.6 0.7 2.8 1.5 0.1 5.0 9.9 9.9 50.2 110.0 45.3	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke c. Lift Cask to Pool Surface c. Lift Cask to Pool Surface c. Install Two Cask Lid Botts b. Lift Cask into Prep/Decon Area Decontamnate Yole and Cask (s) c. Descripage Yoke and Lid Sing from Cask b. Attach Vent and Drain Lines Drain Cask(s) c. Secure Cask Botted Lid(s) Connect Drying and Inerling Equipment	200 285 100 55 200 100 55 110 56 100	20 25 25 10 10 10 5 20 20 80 80 10 10 10 5 5 5 6 10		Operators Rogman Crane Operator Operators Crane Operator Rogman Orane Operator	2 30 30 40 10 20 20 10 20 20 20 22 10 20 22 22 22 22 22 210	00 00 01 01 02 02 03 05 1.8: 0.5 17: 8.7! 0.5: 431 601 601 601 17: 8.7!	0.0 0.0 0.0 0.0 0.0 0.0 1.2 0.2 11.6 0.7 2.8 1.5 0.1 5.0 9.9 5.0 2.1 1.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface d. Imstall Two Cask Lid Bots Lift Cask rito Prep/Decon Area Deconformable Yoke and Cask (s) b. Deengage Yoke and Lid Sing from Cask Artiach Vent and Drain Lines Drain Cask(s) HP Survey(s) Connect Drying and Inerting Eautoment Impact Cask Bots of Lid(s) Connect Drying and Inerting Eautoment Impact Cask(s) In Drain, Dry, and Inert Cask(s)	200 285 100 55 200 100 55 110 56 100	20 25 25 10 10 5 20 20 80 80 10 10 10 5 35 35 35 10	2 2 1 1 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Operator Roperators Roperators Crans Operator Operators Crans Operator Operator Operator Operator Operator Operator Operator Coperator Operator Coperator Coperator Operator	2 30 30 40 10 20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 00 01 01 02 02 03 05 17: 8.7: 0.5: 17: 8.7: 0.5: 17: 43: 60: 60: 60: 17: 8.7: 60: 17: 8.7: 60: 17: 8.7: 8.7: 8.7: 8.7: 8.7: 8.7: 8.7: 8.	0.0 0.0 0.0 0.0 0.0 0.0 1.2 0.2 11.6 0.7 2.8 1.5 0.1 1.5 0.7 9.9 9.9 10.0 10.0 10.0 10.0 10.0 10.0 1	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface d. Install Two Cask Lid Bots b. Lift Cask rate Prepr/Decon Area Deconformatie Yoke and Cask (s) b. Deengage Yoke and Lid Sing from Cask A. Artach Vent and Dran Lines Dran Cask(s) HP Survey(s) C. Secure Cask Bothed Lid(s) Connect Dryng and Inerting Eaulpment In. Drain, Dry, and inerting Eaulpment The Remove Dran, Dryng, and inerting Equipment	200 255 100 50 200 100 550 110 800 555 100	201 255 255 260 100 100 5 300 800 100 100 100 100 100 100 100 100 1	2 2 1 1 2 2 1 1 1 2 2 1 1 1 1 1 1 1 1 1	Operator Operators Ragman Crans Operator Operators Crans Operator Ragman Crans Operator	2 30 30 40 10 20 20 10 20 20 20 22 10 20 22 22 22 22 22 210	00 00 01 01 02 02 03 05 1.8: 0.5 17: 8.7! 0.5: 431 601 601 601 17: 8.7!	0.0 0.0 0.0 0.0 0.0 0.0 1.2 0.2 11.6 0.7 2.8 1.5 0.1 5.0 9.9 5.0 2.1 1.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface s. Install Two Cask Lid Bots b. Lift Cask nito Prepr/Decon Area Deconformatie Yoke and Cask (s) b. Deengage Yoke and Lid Sing from Cask Attach Vent and Dran Lines Dran Cask(s) by Survey(s) c Secure Cask Botted Lid(s) Connect Dryng and Insting Eaulpment In. Drain, Dry, and Inet Cask(s) Remove Dran, Dryng, and Ineting Equipment Con Perform Leak Test on Seal(s)	200 255 100 500 100 500 1100 500 1100 100	20) 25] 25] 26] 20] 30] 30] 30] 30] 31] 32] 33] 35] 36] 36] 36] 36] 36] 36] 36] 36] 36] 36		Operator Operators Ragman Orane Operator Operators Operators Operator Operator Operator Operator Operator Operator Operator Operator Operator Coperator Operator	2 30 30 40 10 20 10 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 00 01 01 02 02 03 05 17: 8.7: 0.5: 17: 8.7: 0.5: 17: 43: 60: 60: 60: 17: 8.7: 60: 17: 8.7: 60: 17: 8.7: 8.7: 8.7: 8.7: 8.7: 8.7: 8.7: 8.	0.0 0.0 0.0 0.0 0.0 0.0 1.2 0.2 11.6 0.7 2.8 1.5 0.1 1.5 0.7 9.9 9.9 10.0 10.0 10.0 10.0 10.0 10.0 1	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface d. Install Two Cask Lid Bots b. Lift Cask rate Prepr/Decon Area Deconformatie Yoke and Cask (s) b. Deengage Yoke and Lid Sing from Cask A. Artach Vent and Dran Lines Dran Cask(s) HP Survey(s) C. Secure Cask Bothed Lid(s) Connect Dryng and Inerting Eaulpment In. Drain, Dry, and inerting Eaulpment The Remove Dran, Dryng, and inerting Equipment	200 285 100 55 200 100 55 110 800 555 100 160 20	20) 25] 25] 26] 20] 30] 30] 30] 30] 31] 32] 33] 35] 36] 36] 36] 36] 36] 36] 36] 36] 36] 36		Operator Operators Ragman Orane Operator Operators Operators Operator Operator Operator Operator Operator Operator Operator Operator Operator Coperator Operator	2 30 30 40 10 20 10 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 00 01 01 02 02 03 05 17: 8.7: 0.5: 17: 8.7: 0.5: 17: 43: 60: 60: 60: 17: 8.7: 60: 17: 8.7: 60: 17: 8.7: 8.7: 8.7: 8.7: 8.7: 8.7: 8.7: 8.	0.0 0.0 0.0 0.0 0.0 0.0 1.2 11.6 0.7 2.8 1.5 0.1 5.0 1.5 0.1 5.0 1.5 0.1 5.0 1.5 0.1 5.0 0.1 5.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
a. Impact Cask Seal (s) a. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface d. Install Two Cask Lid Bots a. Lift Cask anto Prep/Decon Area Deconformate Yoke and Cask (s) a. Desengage Yoke and Lid Sing from Cask A. Artach Vent and Drain Lines Drain Cask(s) HP Survey(s) Connect Drying and Inerting Equipment a. Drain, Dry, and Ihert Cask(s) a. Remove Drain, Drying, and Inerting Equipment a. Perform Leak Test on Seal(s) Testal	200 25 10 5 20 10 10 5 110 80 10 10 10 10 10 10 20 20 20 20 20 20 20 20 20 20 20 20 20	201 253 253 253 263 200 200 200 200 200 100 100 100 100 100		Operator Operators Rogman Crane Operator Operators Crane Operator Operator Operator Operator Operator Operator Operator Operator Operator Coperator Operator	2 30 30 40 10 20 20 10 20 20 20 20 22 2 2 2 2 2 2	00 00 01 00 01 00 00 00 1.8; 0.5 0.5 17; 8.7; 0.5 17; 8.7; 60; 17; 8.7; 60; 17; 8.7; 60; 17; 8.7; 60; 17; 8.7; 60; 17; 18; 19; 10; 10; 10; 10; 10; 10; 10; 10; 10; 10	0.0 0.0 0.0 0.0 0.0 0.0 1.2 11.6 0.7 2.8 1.5 0.1 5.0 1.5 0.1 5.0 1.5 0.1 5.0 1.5 0.1 5.0 0.1 5.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
a. Impact Cask Seal (s) a. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface d. Install Two Cask Lid Bots a. Lift Cask anto Prep/Decon Area Deconformate Yoke and Cask (s) a. Desengage Yoke and Lid Sing from Cask A. Attach Vent and Dran Lines Dran Casks) HP Survey(s) Connect Drying and Inerting Equipment a. Drain, Dry, and Iper Casks) a. Remove Dran, Drying, and Inerting Equipment b. Perform Linck Terraportation Cask from Pool Prep Area La. Prep Truck Transportation Cask from Pool Prep Area La. Prep Truck T	200 25 10 5 20 10 10 5 110 80 10 10 10 10 10 10 20 20 20 20 20 20 20 20 20 20 20 20 20	20) 25] 25] 26] 20] 20] 80] 80] 10] 10] 10] 5 35] 35] 56] 160] 160] 160] 160]		Operators Operators Ragman Crans Operator Operators Crans Operator Ragman Crans Operator	2 30 30 40 10 20 20 10 20 20 20 20 22 2 2 2 2 2 2	00 00 01 00 01 00 00 00 1.8; 0.5 0.5 17; 8.7; 0.5 17; 8.7; 60; 17; 8.7; 60; 17; 8.7; 60; 17; 8.7; 60; 17; 8.7; 60; 17; 18; 19; 10; 10; 10; 10; 10; 10; 10; 10; 10; 10	0.0 0.0 0.0 0.0 0.0 0.0 1.2 11.6 0.7 2.8 1.5 0.1 5.0 1.5 0.1 5.0 1.5 0.1 5.0 1.5 0.1 5.0 0.1 5.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
Inspect Cask Seal (s) Place Cask Lid and Engage Yoke Lift Cask to Pool Surface Install Two Cask Lid Bots Lift Cask into Prep/Decon Area Decontaminate Yoke and Cask (s) Deengage Yoke and Lid Sing from Cask Attach Vert and Drain Lines Drain Cask(s) PP Survey(s) Secure Cask Botted Lid(s) Connect Drying and Inerting Equipment Drain, Dry, and Inert Cask(s) Remove Drain, Drying, and Inerting Equipment Perform Linek Test on Seal(s) Total Connect Drying Press Area Door	200 255 100 55 200 100 55 1100 800 556 100 160 200 620	201 255 255 250 100 100 5 300 800 100 100 100 100 100 100 100 100 1		Operator Operators Ragman Orans Operator Operators Crans Operator Operator Operator Operator Operator Operator Operator Crans Operator Operator Crans Operator Operator Crans Operator Operator Ragman Operator	2 30 30 40 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 00 00 00 00 1.8: 0.5 17: 8.7! 0.5 17: 43: 43: 40: 60: 17: 43: 60: 17: 43: 43: 43: 43: 44: 45: 46: 46: 46: 46: 46: 46: 46: 46: 46: 46	0.0 0.0 0.0 0.0 0.0 0.0 0.0 1.2 0.2 11.6 0.7 2.8 1.5 0.7 5.0 9.9 5.0 10.0 45.3 23.2 10.0 5.7 292.5	
Inspect Cask Seal (s) Place Cask Lid and Engage Yoke Lift Cask to Pool Surface Install Two Cask Lid Bolts Lift Cask into Prep/Decon Area Decontamnate Yoke and Cask (s) Desengage Yoke and Lid Sing from Cask Affach Veril and Drain Lines Drain Cask(s) HP Survey(s) Secure Cask Bolted Lid(s) Connect Diving and Inerting Equipment Drain, Dry, and Inert Cask(s) Remove Drain, Drying, and herting Equipment Protot Remove Drain, Drying, and herting Equipment Decon Leak Test on Seal(s) Total Total Total John Prep Area Door B. Move On-Site PM and Bransporter to Prep Area Door Area Door Decon Prep Area Door	200 25 100 55 200 100 55 1100 800 1600 1600 200 6200 55 100 100 100 100 100 100 100 100 100 100	20) 25] 25] 26] 10) 10) 20) 20) 80) 80) 10) 10) 10) 10) 10) 10) 10) 10) 10) 1		Operator Operators Rogman Crane Operator Operators Crane Operator	2 30 30 40 10 20 20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 01 00 01 00 00 1.8: 0.5 0.5 17: 8.7: 0.5 17: 43: 600 600 600 17: 17: 17: 17: 17: 17: 17: 17: 17: 17:	0.0 0.0 0.0 0.0 0.0 0.0 1.2 0.2 11.6 0.7 2.8 1.5 0.1 5.0 1.5 0.1 5.0 1.5 0.1 5.0 1.5 0.1 5.0 1.0 5.0 0.0 0.0 0.0 0.0 0.0 0.0 0	
Inspect Cask Seal (s) Prace Cask Lid and Engage Yoke Lift Cask to Pool Surface Install Two Cask Lid Botts Lift Cask into Prep/Decon Area Decontaminate Yoke and Cask (s) Desingage Yoke and Lid Sting from Cask Attach Veril and Drain Lines Drain Cask(s) Desingage Yoke and Lid Sting from Cask Attach Veril and Drain Lines Drain Cask(s) Proving Cask Bottled Lid(s) Connect Daying and Inerting Equipment Drain, Dry, and Inert Cask(s) Remove Drain, Drying, and Inerting Equipment Perform Leak Test on Seal(s) Total	200 255 100 500 100 500 1100 500 100 100 200 620 500 500 500 500 500 500 500 500 500 5	201 253 253 263 260 200 200 200 200 200 200 200 200 200		Operators Rogman Crane Operator Operators Crane Operator Operators Crane Operator	2 30 30 40 10 20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 00 00 00 00 1.8: 0.5 17: 8.7! 600 17: 8.7! 600 17: 8.7! 600 17: 8.7! 600 17: 8.7! 8.7! 8.7! 8.7! 8.7! 8.7! 8.7! 8.7!	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
Inspect Cask Seal (s) Place Cask Lid and Engage Yoke Lift Cask to Pool Surface Install Two Cask Lid Bolts Lift Cask into Prep/Decon Area Decontamnate Yoke and Cask (s) Desengage Yoke and Lid Sing from Cask Affach Veril and Drain Lines Drain Cask(s) HP Survey(s) Secure Cask Bolted Lid(s) Connect Diving and Inerting Equipment Drain, Dry, and Inert Cask(s) Remove Drain, Drying, and herting Equipment Protot Remove Drain, Drying, and herting Equipment Decon Leak Test on Seal(s) Total Total Total John Prep Area Door B. Move On-Site PM and Bransporter to Prep Area Door Area Door Decon Prep Area Door	200 255 100 50 100 50 1100 800 100 100 100 420 420 5 100 100 100 100 100 100 100 100 100	201 253 253 253 263 200 200 200 200 200 200 200 200 200 20		Operators Roperators Roperators Crane Operator Operators Crane Operator Operator Operator Operator Operator Operator Operator Operator Coperator Operator	2 30 30 40 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 00 00 00 00 00 00 00 00 00 00 00	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.7 2.8 1.5 0.1 5.0 9.9 50.2 110.0 5.0 10.0 5.7 28.2 10.0 5.0 5.0 10.0 10.0 10.0 10.0 10.0 1	
Inspect Cask Seal (s) Prace Cask Lid and Engage Yoke Lift Cask to Pool Surface Install Two Cask Lid Botts Lift Cask into Prep/Decon Area Decontaminate Yoke and Cask (s) Desingage Yoke and Lid Sting from Cask Attach Veril and Drain Lines Drain Cask(s) Desingage Yoke and Lid Sting from Cask Attach Veril and Drain Lines Drain Cask(s) Proving Cask Bottled Lid(s) Connect Daying and Inerting Equipment Drain, Dry, and Inert Cask(s) Remove Drain, Drying, and Inerting Equipment Perform Leak Test on Seal(s) Total	200 255 100 500 100 500 1100 500 100 100 200 620 100 550 550 550 550 550 550 550 550 55	20) 25 25 25 26 10 10 10 5 20 20 80 10 10 10 10 10 10 10 10 10 10 10 10 10		Operators Operators Ragman Crans Operator Operators Crans Operator	2 30 30 40 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 00 00 00 00 00 00 00 1.8: 0.5 17: 0.5 17: 43: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 60: 60: 60: 60: 60: 60: 60: 60: 60	0.0 0.0 0.0 0.0 0.0 0.0 0.0 1.2 0.7 2.8 1.5 0.1 5.0 9.9 50.2 110.0 10.0 5.7 292.3 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface 1. Install Two Cask Lid Bots b. Lift Cask nito Prepr/Decon Area Deconformatie Yoke and Cask (s) b. Deengage Yoke and Lid Sing from Cask A Artach Vent and Dran Lines Dran Cask(s) b. Pron Cask(s) c. Secure Cask Bothed Lid(s) c. Secure Cask Bothed Lid(s) c. Connect Dryng and Inerting Equipment b. Drain, Dry, and Inert Cask(s) c. Remove Dran, Dryng, and Inerting Equipment c. Perform Leak Test on Seal(s) Total Ba. Prep Insck Transportation Cask from Pool Prep Are a. Open Prep Area Door b. Move On-Site PM and Transporter to Prep Are c. Unividen On-Site PM d. Engage Yoke to Cask	200 255 100 500 100 550 1100 200 620 550 100 550 100 550 100 100 100 100 10	20) 25 25 25 26 10 10 10 5 20 80 80 10 10 10 10 10 10 10 10 10 10 10 10 10		Operators Operators Rogman Orans Operator Operators Operators Operators Operator	2 30 30 40 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 00 00 00 00 00 00 00 00 00 00 00	0.0 0.0 0.0 0.0 0.0 0.0 0.0 1.2 0.2 11.6 0.7 2.8 1.5 0.1 10.0 10.0 45.3 27 29.2 10.0 10.	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface d. Install Two Cask Lid Bots Lift Cask into Prep/Decon Area Decontaminate Yoke and Cask (s) Desingage Yoke and Lid Sing from Cask A Attach Veril and Drain Lines Drain Cask(s) HP Survey(s) Connect Drying and Inerting Equipment To Drain, Dry, and Inert Cask(s) Remove Drain, Drying, and Inerting Equipment Perform Lack Test on Seal(s) Total Tota	200 25 10 5 20 80 10 5 110 85 10 160 20 420 10 10 10 10 10 10 10 10 10 10 10 10 10	20) 25] 25] 26] 26] 27] 20] 20] 20] 20] 20] 20] 20] 20] 20] 20		Operators Rogerators Rogerators Crane Operator Operators Crane Operator	2 30 30 40 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 01 00 01 00 00 05 0.5 17 8.7 10 60 60 17 17 8.7 17 17 17 17 17 17 17 17 17 17 17 17 17	0.0 0.0 0.0 0.0 0.0 0.0 0.0 1.2 0.2 11.6 0.7 2.8 1.5 0.1 5.0 1.5 0.1 5.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface d. Install Two Cask Lid Bots Lift Cask nito Prep/Decon Area Deconformatie Yoke and Cask (s) b. Deengage Yoke and Lid Sing from Cask Attach Vent and Dran Lines Dran Cask(s) Lift Cask more and Dran Lines Dran Cask(s) Lift Cask (s) Connect Dryng and Institute Lift Cask (s) Lift Cas	200 255 100 500 100 550 1100 200 620 550 100 550 100 550 100 100 100 100 10	201 255 255 260 200 200 200 200 200 200 200 200 200		Operators Operators Rogman Crane Operator Operators Crane Operator	2 30 30 10 20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 00 00 00 00 1.8: 0.5 8.7! 0.5 43 43 43 43 40 17 8.7! 60 17 8.7! 8.7! 8.7! 8.7! 8.7! 8.7! 8.7! 8.7!	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface d. Install Two Cask Lid Both Lift Cask not Prep/Decon Area Lift Cask not Prep/Decon Area Decontaminate Yoke and Cask (s) Descripage Yoke and Lid Sing from Cask Attach Vent and Drain Lines Drain Cosk(s) HP Survey(s) Connect Drying and Inerting Equipment Drain, Dry, and Inert Cask(s) Remove Drain, Drying, and herting Equipment Remove Drain, Drying, and herting Equipment Drain, Dry and Inert Cask(s) Total Sa. Prep Track Transportation Cask from Peol Prep Area. Open Prep Area Door b. Move On-Site PM and Transporter to Prep Area. Unhitch On-Site PM d. Engage Yoke to Cask d1 Case Pool Prep Area Door, simultaneous	200 25 10 5 20 80 10 5 110 85 10 160 20 420 10 10 10 10 10 10 10 10 10 10 10 10 10	20) 25] 25] 26] 26] 27] 20] 20] 20] 20] 20] 20] 20] 20] 20] 20		Operators Rogerators Rogerators Crane Operator Operators Crane Operator	2 30 30 40 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 01 00 01 00 00 05 0.5 17 8.7 10 60 60 17 17 8.7 17 17 17 17 17 17 17 17 17 17 17 17 17	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
2. Impact Cask Seal (s) 2. Place Cask Lid and Engage Yoke 2. Lift Cask to Pool Surface 3. Install Two Cask Lid Both 3. Lift Cask into Prep/Decon Area 4. Lift Cask into Prep/Decon Area 5. Decontaminate 6. Voke and Cask (s) 9. Deengage Yoke and Lid Sing from Cask 6. Artach Vent and Drain Lines 6. Drain Cask(s) 1. HP Survey(s) 6. Seaure Cask Bothed Lid(s) 6. Connect Drying and Inerting Equipment 6. Drain, Dry, and Inert Cask(s) 7. Remove Drain, Drying, and herting Equipment 6. Perform Lick Test on Seal(s) 7. Total 6. Prep Track Transportation Cask from Pool Prep Area 6. Unit that On-Site PM and Transporter to Prep Are 6. Unit that On-Site PM 7. Cask Pool Prep Area Door, stmuttaneoust 8. Pace Cask on Transporter 8. Pace Cask on Transporter 9. Pace Cask on Transporter	200 255 100 55 200 100 55 1100 55 100 1600 200 4200 100 55 100 100 100 100 100 100 100 10	201 253 253 253 260 200 200 200 200 200 200 200 200 200		Operators Operators Rogman Crane Operator Operators Crane Operator	2 30 30 10 20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 00 00 00 00 1.8: 0.5 8.7! 0.5 43 43 43 43 40 17 8.7! 60 17 8.7! 8.7! 8.7! 8.7! 8.7! 8.7! 8.7! 8.7!	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface d. Install Two Cask Lid Bots a. Lift Cask rito Prep/Decon Area Decontaminate Yoke and Cask (s) b. Deengage Yoke and Lid Sing from Cask A. Artiach Vent and Drain Lines Drain Cask(s) b. Person Cask Bots d Lid(s) Connect Drying and Inerting Eastpment b. Drain, Dry, and liner Cask(s) b. Remove Drain, Drying, and Inerting Equipment b. Perform Lick Test on Seal(s) Total Ea. Prep Track Tixtreportation Cask from Pool Prep Area C. Unhitch On-Site PM d. Engage Yoke to Cask d1 Case Pool Prep Area Door, stmultaneoust e. Place Casi: on Tixtreporter f. Perform Reliables HP Survey	200 255 100 500 100 100 100 100 100 420 420 100 100 100 100 100 100 100 100 100 1	20) 25 25 25 26 20 10 10 30 20 20 60 10 10 10 10 10 10 10 10 10 10 10 10 10		Operators Operators Ragman Crans Operator Operators Crans Operator Operators Operator Operator Operator Operator Operator Coperator Operator	2 30 30 40 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 00 00 00 00 00 00 00 00 1.8: 17: 0.5: 17: 43: 43: 40: 17: 43: 40: 17: 43: 40: 17: 43: 40: 17: 43: 40: 17: 43: 40: 17: 43: 40: 40: 40: 40: 40: 40: 40: 40: 40: 40	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	4
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface d. Install Two Cask Lid Bots a. Lift Cask into Prep/Decon Area Decontaminate Yoke and Cask (s) Deengage Yoke and Lid Sing from Cask Attach Vent and Dran Lines Dran Cask(s) HP Survey(s) Connect Drying and Inerting Equipment To Drain, Dry, and Inert Cask(s) Remove Dran, Drying, and Inerting Equipment D. Perform Lick Test on Seal(s) Total Ea. Prep Track Tierrisportation Cask from Pool Prep Area Door b. Move Oriste PM and Transporter to Prep Area C. Unitich On-Site PM and Transporter to Prep Area C. Unitich On-Site PM d. Engage Yoke to Cask d1 Case Pool Prep Area Door, stmultaneoust e. Place Cask: on Transporter	200 255 100 50 100 100 100 100 100 100 100 10	201 255 255 256 201 200 800 800 100 100 100 100 100 100 100 1		Operators Rogerators Rogerators Crane Operator Operators Crane Operator Rogerator Operator	2 30 30 40 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 00 00 00 00 00 00 00 00 00 00 00	0.0 0.0 0.0 0.0 0.0 0.0 0.0 1.2 0.7 2.8 1.5 0.1 1.0 1.5 0.7 2.8 1.5 0.1 1.0 2.8 1.5 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
a. Impact Cask Seal (s) b. Place Cask Lid and Engage Yoke Lift Cask to Pool Surface d. Install Two Cask Lid Bots a. Lift Cask into Prep/Decon Area Deconformable Yoke and Cask (s) b. Desingage Yoke and Lid Sing from Cask A. Artiach Vent and Drain Lines Drain Casks) APP Survey(s) Connect Drying and Inerting Equipment b. Drain, Dry, and liner Casks) Remove Drain, Drying, and Inerting Equipment c. Perform Leak Test on Seal(s) Total G. Prep Track Tixtrisportation Cask from Pool Prep Area a. Open Prep Area Door b. Move On-Site PM and Transporter to Prep Area c. Unhitch On-Site PM d. Engage Yoke to Cask d1 Case Pool Prep Area Door, stmultaneous e. Place Casi: on Transporter f. Perform Relicase MP Survey	200 255 100 50 100 100 100 100 100 100 100 10	20) 25] 25] 26] 26] 27] 20] 20] 20] 20] 20] 20] 20] 20] 20] 20		Operators Operators Ragman Crans Operator Operators Crans Operator Operators Operator Operator Operator Operator Operator Coperator Operator	2 30 30 40 10 20 20 20 20 20 20 20 20 20 20 20 20 20	00 00 00 00 00 00 00 1.8: 0.5: 17: 8.7: 0.5: 17: 43: 60: 17: 43: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 60: 17: 17: 17: 17: 17: 17: 17: 17: 17: 17	0.0 0.0 0.0 0.0 0.0 0.0 0.0 1.2 0.2 11.6 0.7 2.8 1.5 0.1 10.0 45.3 23.2 10.0 5.7 292.3 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	4

Table A1-1. Utilities-Reference (continued)

		421			2.	321	64.0	0.
i, kristati Personnel Barrier	60	30		Operators Crane Operator		0.5	0.3	- <u>~</u>
	10	찅		Operator	0	0	0.01	ā
j. Prepare Shipping Papers	5	- 8		Operator	Ö.	히	0.0	a
k, Open Prep Area Door	10	101		Prime Mover Operator		0.5	0.1	0
L Hitch On-Site Prime Mover	20	20		Prime Mover Operator		0.5	0.2	Õ
m. Move Cask to Protected Area Gale		. 5		Security Officers	2	17	3.4	ō
n. Perform security check	5	5		Prime Mover Operator		0.5	0.0	Ō.
o. Un-hitch On-Sile Prime Mover	5			Prime Mover Operator		0.5	0.0	Ŏ
p. Hitch Off-Site Prime Mover	5	5		Preside Warver Coperator	- 	~~ +	168.7	Ō
Total	310	410				-+	100.1	
						-+		
Prep Rail Transportation Cask from Pool Prep Area	<u>to i</u>			casume null bookgroun		-+		_
Ship three are scaled by diameter ratio to rail	from 5a		1.8	scale perimeter from in				
Open Prep Area Door	5	0		Operator	<u>:_0:</u>	0	0.0	0.
Move On-Site PM and Transporter to Prep Area	10	10	1	Prime Mover Operator	15	0.5	0.1	0
Unhitch On-Site PM	5	5	1	Prime Mover Operator	15:	0.5	0.01	0
OTERCH CHARLETEN	10	10	1	Operator	2	17	2.8	0
Engage Yake to Cask		10	1	Rogman	10	8.7	1.5	0
	 	10		Crane Operator	20	0.5	0.1	0
	j	0		Operator	0:	0	0.0	-0
 Close Pool Prep Area Door, simultaneously with St 	45	45			10	1.8	2.7	0
Pictor Cosk on Transporter				CODUCTO TO	20!	0.5	0.4	0
	 	45		Crane Operator	2	43	50.2	_
Perform Release HP Survey(s -diameter)	80	35						_
Install Cosk Restraints(s-perimeter)	35	35			21	32	37.3	- 0
		35		Crone Operator	20:	0.5	0.3	_
Install Impact Limiters(s-cliameter)	55	55		Operators	2:	32	58.7	_
COLUMN CONTRACTOR CONT		55	1	Crane Operator	20:	0.5	0.5	
A Burnanal Portage maringen	70	70		Operators	2:	32	74.7	
ristal Parsonnel Barrier(s-perimeter)	 	35	 ī	Crane Operator	20	0.5	0.3	_(
	10	- 3		Operator	0,	0	0.0	- (
Prepare Shipping Papers	5	- 0		Operator	· O!	히	0.0	-
Open Prep Area Door					15:	0.5	0.01	-
Hitch Co-Ste Prime Mover	5	5		Prime Mover Operator		0.5	0.3	
Move Cask to Protected Area Gate (rull backgrou	r 30	30		Plirie Mover Operator			3.4	
Perform security check	5	5		Security Officers	2:	17		_
Un-hitch On-Site Prime Mover	5	5		Parne Mover Operator		0.5	0.0	
. Make-up with other cask cars per train (assume 3 a	d 60	60	2	Operator-rail	15	1.2	24;	_
Hitch Off-Site Prime Mover (assume rail siding dose s	5	5		Prime Mover Operator	15	0.5	0.0	_ (
	440	545		1			235.6	_ 1
Total	; 							
	 			ne background dose		-1		
Receive Empty MESC	+				0.	0	0.0	-
a. Inspect Bills of Lading, Other Shipping Papers	30	10		Operator		-6	0.0	
h. Take MESC to Warehouse	60	60		Prime Mover Operator			0.0	-
c. Up-end MESC at Warehouse and Stare	30	30		Operators	10	_		_
	11	30		Crane Operator	20:	0	0.0	_
cl. Release Off-Site Prime Mover (PM)	10	10	1	Prime Mover Operator		0		
e, Hitch On-Site PM	10	10		Prime Mover Operator		0		
1. Move MESC to Protected Area	20	20	1	Prime Mover Operator	15	0		_
g. Security Inspection(casume crone enclosure)	30	30	-	2 Security Officers	2	0	0.0	_
O. SOCUMY PROGRAMMENT COMMENTS	5	5		Operator	0.	0	0.0	
h, Open Stoging Area Door	30	30		Prime Mover Operator	15	0	0.0	
L Move MESC to Stoging Area	- 20	40		2 Radiation Protection	2.	0	0.0	
j. Perform Prefirminary HP Survey of MESC	10	10		2 Operators	2.	Ö	89	
k. Attach Lifting Device to MESC	+ 10		_	1 Rooman	10	- 5		
		10						_
				1	20			_
		10		1 Crane Operator	20_	_		1
k1. Close Stoging Area Door, simultaneously with St	p k	10		1 Operator	0.	0	0.0	
k1. Close Staging Area Door, simultaneously with St L Urt MESC into Prep Area	10 k.	10 30		1 Operator 2 Operators	0· 10	0	0.0	
k1. Close Staging Area Door, simultaneously with Ste L Lith MESC into Prep Area	30	10 30 30		1 Operator	0.	0	0.0 0.0	
I, Uff MESC Into Prep Area	30 205	10 30 30		1 Operator 2 Operators	0· 10	0	0.0	
L Un MESC Into Prep Area	285	10 30 30 376		1 Operator 2 Operators 1 Crane Operator	0· 10 20	0	0.0 0.0 0.0	
L Un MESC Into Prep Area	285	30 30 375		1 Operator 2 Operators 1 Orane Operator assume unloaded car	0. 10 20 k in cron	0 0	0.0 0.0 0.0 0.0 closure	E
Lun MESC Into Prep Area Total 7. Receive Unloaded On-Site MESC Transfer Casic: 1	285	30 30 375		1 Operator 2 Operators 1 Crane Operator assume unloaded cos 2 Operators	0. 10 20 k in exan	0 0	0.0 0.0 0.0 0.0 0.0 0.0	E
L Un MESC Into Prep Area	285 SFSI To P	30 30 375		1 Operator 2 Operators 1 Orane Operator assume unloaded car	0. 10 20 k in cron 10 r . 15	0 0	0.0 0.0 0.0 0.0 0.0 closure	
Lun MESC Into Prep Area Total 7. Receive Unloaded On-Site MESC Transfer Casic: 1	285 SFSI To P	10 30 30 375 rep		1 Operator 2 Operators 1 Crane Operator assume unloaded cos 2 Operators	0 10 20 k in eran 10 r 15 20	0 0	0.0 0.0 0.0 0.0 0.0 0.0 0.0	
Lun MESC Into Prep Area Total 7. Receive Unloaded On-Site MESC Transfer Casic: 1	285 SFSI To P	10 30 30 375 80 60		1 Operator 2 Operators 1 Crane Operator assume unloaded car 2 Operators 1 Prime Mover Operator	0. 10 20 k in cron 10 r . 15	0 0	0.0 0.0 0.0 0.0 0.0 0.0 0.0	
L Un MESC Into Prep Area Total 7. Receive Unloaded On-Sile MESC Isanster Cask: 1 a. Move Cask to Storage	285 SFSI To P	10 30 30 375 80 60 60 60		1 Operator 2 Operator 11 Crane Operator assume unloaded cas 2 Operator 1 Prime Mover Operato 1 Crane Operator 1 Radiation Protection	0 10 20 k in eran 10 r 15 20	0 0	0.0 0.0 0.0 0.0 0.0 0.0 0.0	
Lun MESC Into Prep Area Total 7. Receive Unloaded On-Site MESC Transfer Casic: 1	285 SFSI To P	10 30 30 375 60 60 60		1 Operator 2 Operator 1 Crane Operator assume unloaded car 2 Operator 1 Prime Mover Operator 1 Crane Operator 1 Radiation Protection 2 Operators	0 10 20 20 k in cron 10 r 15 20 10	0 0 0	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
L Un MESC Into Prep Area Total 7. Receive Unloaded On-Sile MESC Isanster Cask: 1 a. Move Cask to Storage	285 SFSI To P	10 30 30 375 60 60 60 55		1 Operator 2 Operator 1 Crane Operator assume unloaded car 2 Operators 1 Prime Mover Operator 1 Crane Operator 1 Radiation Protection 2 Operators 1 Prime Mover Operator	0 10 20 20 k in cron 10 r 15 20 10	000000000000000000000000000000000000000	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
L Un MESC Into Prep Area Total 7. Receive Unloaded On-Sile MESC Isanster Cask: 1 a. Move Cask to Storage	285 SFSI To P	10 30 30 375 60 60 60 55		1 Operator 2 Operator 1 Crane Operator assume unloaded cor 2 Operators 1 Prime Mover Operator 1 Crane Operator 1 Rodiction Protection 2 Operators 1 Prime Mover Operator 1 Crane Operator	0. 10 20 20 k in eran 10 r 15 20 10 10 f 15	000000000000000000000000000000000000000	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
I, Un MESC into Prep Area Sotal 7. Receive Unloaded On-Site MESC Transfer Cask: 1 a. Move Cask to Storage b. Release On-site PM	285 SFSI To P 60	10 30 30 376 60 60 60 55		1 Operator 2 Operator 1 Crane Operator 2 Operator assume unloaded car 2 Operator 1 Prime Mover Operator 1 Roadation Protection 2 Operator 1 Prime Mover Operator 1 Prime Mover Operator 1 Prime Mover Operator 1 Roadation Protection	0. 10 20 20 k in eran 10 r 15 20 10 f 15 20:	000000000000000000000000000000000000000	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
L Un MESC Into Prep Area Total 7. Receive Unloaded On-Sile MESC Isanster Cask: 1 a. Move Cask to Storage	285 SFSI To P	10 30 30 375 60 60 60 55 55 5		1 Operator 2 Operator 1 Crane Operator assume unloaded car 2 Operator 1 Prime Mover Operator 1 Roadiation Protection 2 Operators 1 Prime Mover Operator 1 Roadiation Protection 2 Operators 1 Prime Mover Operator 1 Roadiation Protection 2 Operators	0 10 20 20 k in crorr 10 7 15 20 10 6 15 20:		0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
I, Un MESC into Prep Area Sotal 7. Receive Unloaded On-Site MESC Transfer Cask: 1 a. Move Cask to Storage b. Release On-site PM	285 SFSI To P 60	10 30 30 375 60 60 60 5 5 5 5		1 Operator 2 Operator 1 Crane Operator 2 Operator 1 Prime Mover Operator 1 Radiation Protection 2 Operators 1 Prime Mover Operator 1 Crane Operator 1 Rodiation Protection 2 Operators 1 Prime Mover Operator 1 Rodiation Protection 2 Operators 1 Prime Mover Operator 2 Operators 1 Prime Mover Operator	0 10 20 20 10 7 15 20 10 10 1 15 20:	0 0 0 0 0 0 0 0 0 0	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
I, Un MESC into Prep Area Sotal 7. Receive Unloaded On-Site MESC Transfer Cask: 1 a. Move Cask to Storage b. Release On-site PM	285 SFSI To P 60	10 30 30 375 60 60 60 5 5 5 5 5 10 10		1 Operator 2 Operator 1 Crane Operator 2 Operator 1 Crane Operator 2 Operators 1 Prime Mover Operator 1 Crane Operator 2 Operators 1 Prime Mover Operator 1 Crane Operator 1 Crane Operator 2 Operators 1 Prime Mover Operator 1 Radiation Protection 2 Operators 1 Prime Mover Operator 1 Crane Operator	0 10 20 20 10 10 10 10 10 15 20 10 10 10 10 10 10 10 10 10 10 10 10 10	000000000000000000000000000000000000000	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
I, Un MESC into Prep Area Total 7. Receive Unloaded On-Site MESC Transfer Cask: 1 a. Move Cask to Storage b. Release On-site PM	285 SFSI To P 60	10 30 30 375 60 60 60 5 5 5 5		1 Operator 2 Operator 1 Crane Operator 2 Operator 1 Prime Mover Operator 1 Radiation Protection 2 Operators 1 Prime Mover Operator 1 Crane Operator 1 Rodiation Protection 2 Operators 1 Prime Mover Operator 1 Rodiation Protection 2 Operators 1 Prime Mover Operator 2 Operators 1 Prime Mover Operator	0 10 20 20 15 20 10 10 10 10 15 20 10 10 15 20 10 10 10 10 15 20 10 10 10 10 10 10 10 10 10 10 10 10 10		0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
L Lift MESC Into Prep Area Total 7. Receive Unloaded On-Sile MESC Isanster Cask: i a. Move Cask to Storage b. Release On-site PM c. Hitch On-Site PM	285 SFSI To P 60	10 30 30 375 60 60 60 5 5 5 5 5 10 10		1 Operator 2 Operator 1 Crane Operator 2 Operator 1 Crane Operator 2 Operators 1 Prime Mover Operator 1 Crane Operator 2 Operators 1 Prime Mover Operator 1 Crane Operator 1 Crane Operator 2 Operators 1 Prime Mover Operator 1 Radiation Protection 2 Operators 1 Prime Mover Operator 1 Crane Operator	0 10 20 10 10 10 15 20 10 15 20: 10 10 10 10 10 10 10 10 10 10 10 10 10		0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
I, Un MESC into Prep Area Total 7. Receive Unloaded On-Site MESC Transfer Cask: 1 a. Move Cask to Storage b. Release On-site PM	305 305 SFSI To P 60	10 30 30 378 60 60 60 5 5 5 5 5 10 10 10		1 Operator 2 Operator 1 Crane Operator 1 Crane Operator 2 Operators 1 Prime Mover Operator 1 Crane Operator 2 Operators 1 Prime Mover Operator 1 Crane Operator 1 Crane Operator 1 Radiation Protection 2 Operators 1 Prime Mover Operator 1 Radiation Protection 2 Operators 1 Prime Mover Operator 1 Radiation Protection 2 Operators 1 Prime Mover Operator 1 Radiation Protection	0 10 20 10 10 10 15 20 10 15 20: 10 10 10: 10: 10: 10: 10: 10: 10: 10:		0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
I, Utt MESC Into Prep Area Total 7. Receive Unloaded On-Sile MESC Isanster Cask: i a. Move Cask to Storage b. Release On-site PM c. Hitch On-Site PM	305 305 SFSI To P 60	10 30 30 376 60 60 60 5 5 5 5 10 10 10 10 20 20		1 Operator 2 Operator 1 Crane Operator 1 Crane Operator 2 Operator 1 Prime Mover Operator 1 Radiation Protection 2 Operator 1 Prime Mover Operator 1 Crane Operator 1 Radiation Protection 2 Operators 1 Prime Mover Operator 1 Crane Operator 1 Crane Operator 2 Operators 1 Radiation Protection 2 Operators 1 Radiation Protection 2 Operators	0 10 20 10 10 10 15 20 10 15 20: 10 10 10: 10: 10: 10: 10: 10: 10: 10:		0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
LUT MESC Into Prep Area Total 7. Receive Unloaded On-Sile MESC Isanster Cask: i a. Move Cask to Storage b. Release On-sile PM c. Hitch On-Sile PM	305 305 SFSI To P 60	10 30 30 376 60 60 60 5 5 5 5 10 10 10 20 20 20		1 Operator 2 Operator 1 Crane Operator 2 Operator 1 Crane Operator 2 Operator 1 Prime Mover Operator 1 Radiation Protection 2 Operator 1 Crane Operator 1 Radiation Protection 2 Operators 1 Prime Mover Operator 1 Crane Operator 1 Radiation Protection 2 Operators 1 Prime Mover Operator 1 Radiation Protection 2 Operators 1 Prime Mover Operator 1 Radiation Protection 2 Operators 1 Prime Mover Operator 1 Crane Operator	0 10 20 20 10 10 15 20 10 10 15 20 10 10 10 10 10 10 10 10 10 10 10 10 10	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
7. Receive Unloaded On-Site MESC Transfer Cask: I a. Move Cask to Storage b. Release On-site PM c. Hitch On-Site PM d. Move Cask to Protected Area	30 285 SERVICE P 60	10 30 30 378 60 60 60 5 5 5 5 10 10 10 10 20 20 20 20 20 20 20 20 20 20 20 20 20		1 Operator 2 Operator 1 Crane Operator 2 Operator 1 Crane Operator 2 Operator 1 Prime Mover Operator 1 Rodiation Protection 2 Operator 1 Prime Mover Operator 1 Rodiation Protection 2 Operator 1 Rodiation Protection 2 Operator 1 Prime Mover Operator 1 Prime Mover Operator 1 Prime Mover Operator 1 Prime Mover Operator 1 Crane Operator 1 Crane Operator 1 Rodiation Protection 2 Operator 1 Prime Mover Operator 1 Crane Operator 1 Prime Mover Operator 1 Prime Mover Operator 1 Rodiation Protection	0 10 20 10 10 10 10 10 10 10 10 10 10 10 10 10	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
LUT MESC Into Prep Area Total 7. Receive Unloaded On-Site MESC Transfer Cask: 1 a. Move Cask to Storage b. Release On-site PM c. Hitch On-Site PM	30 286 BSSI To P 60 60 60 60 60 60 60 60 60 60 60 60 60	10 30 30 378 60 60 60 5 5 5 5 10 10 10 20 20 20 20 30 30 30 40 40 40 40 40 40 40 40 40 40 40 40 40		1 Operator 2 Operator 1 Crane Operator 2 Operator 1 Crane Operator 2 Operator 1 Prime Mover Operator 1 Radiation Protection 2 Operator 1 Crane Operator 1 Radiation Protection 2 Operators 1 Prime Mover Operator 1 Crane Operator 1 Radiation Protection 2 Operators 1 Prime Mover Operator 1 Radiation Protection 2 Operators 1 Prime Mover Operator 1 Radiation Protection 2 Operators 1 Prime Mover Operator 1 Crane Operator	0 10 20 10 10 10 10 10 10 10 10 10 10 10 10 10		0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	

Table A1-1. Utilities-Reference (continued)

					14	Ö	0.0	0.0
h. Release PM	5	5		Prime Mover Operator	15	- 61	00	01
L Close Prep Ania Door(use decon area backgra	5	5 40		Operator Radiation Protection	2,	히	0.0	1.3
J. Perform Preliminary HP Survey	40	60		Operators	2.	히	90	2.0
k. Decontaminate Cark	60	60		Operators	2	히	0.0	20
L Remove Cask Restraints	40	40		Radiation Protection	2	- 8	90	1.3
m. Perform HP Survey	40	-60		Operators	2	Oi	0.0	2.0
n. Decontaminate Cask		5		Operator	2	01	0.0	0.1
o. Engage Yoke to Cask		5		Operator	10	0	0.0	0.1
		<u> </u>		Crane Operator	20	0	0.0	0.1
	25	25		Operators	10	0	0.0	0.8
p. Lift Cark into Prep Area	- -	25		Crane Operator	20	Ö	0.0	0.4
	460	780		Carcpace			0.0	12.5
otal								
	-			assume arane enclosus	e back	Tourio		
Load Empty MESC into Transfer-overpack	70	10		Operator	2	O	0.0	0.0
Align MESC with Cook		10			· 10·	0	0.0	90
	 	101		Crane Operator	20	0	0.0	0.0
	20	20		Operators	2	0	0.0	8
Lower MESC Into Cook	 	200		Operator	; 10	0	0.0	0.1
	 	200		Crans Operator	20	0	0.0	0.1
1950 Davies Com MESC	10	30		Operator	2	0	0.0	9
Disengage and Remove Lifting Device From MESC	 	iol		Operator	10	<u> </u>	0.0	00
	10	10		Operators	1 2	0	0.0	0.1
1 Verify MESC Configuration for SNF	30	:0		Operators	2	0	0.0	0.3
Fill Annulus with Demineralized Water Install MESC Confamination Protection	30	-::		Operators	2	0	0.0	0.3
Install MESC Conformation Projection	- 5	- 3		Operators	2	0	0.0	0.0
Connect Annulus Float Hoses	60	- ,50		Operators	2	ol	0.0	0.5
A FILMESC With Water	175	245		Operation			0.0	1.7
Total	 -'/* }	<u>~~~</u>		<u> </u>	,	$\neg \uparrow$		
	├──			casume crane area bo	ckorous	o inti	9 V	
Peop Unloaded NESC/Transfer for Pool	10	10		Operator	2	O	0.0	0.0
a. Attach Cask Yoke to Crane	 - '4	10		Rooman	10	- 0	0.0	0.0
	} +	10		Crane Operator	20	히	0.0	0.0
	 			Coerctor	2	ö	0.0	0.1
b. Engage Yoke to Cask	25	_ 25			7 10	- 6	0.0	0.1
	1	25		Rooman	20	0	0.0	0.1
	 	25		Crone Operator	: 10:	- 6	0.0	0.3
c. Move Cask to Fuel Loading Pool Roor	30	30		Operators	20	- 6	0.0	0.1
(resume pool greg (sockground)	 	30		Crane Operator	30	- 8	0.0	7.0
d. Disengage Yoke From Cask	20	20		Operator	30	0	0.0	1.0
	4	20		I Ragman	40	- 6	0.0	-120
	4	20		Crane Operator	10	0	0.0	1.0
e. Remove Yoke From Pool	10	10		Operators	10	8	0.0	0.5
	4	10		Ragman	· 20	- 5	0.0	0.5
	اا	10		Crane Operator	<u>· &</u>		9.0	5.8
iotal	95	255		 				
	- 			 				
10. Lood SNF Into MESC/fransfer	1 5							1.0
1010000		10		NO CONTRACTOR OF THE PARTY OF T	20	0.51	0.2	
a SNE Correyle Attrached to CRINE	10	10		2iOperators	20	0.5	0.2	0.0
SNF Grappie Attached to Crane Brigage Cris SNF Assembly, (12 min. per assembly).	entry?			<u> </u>			0.0	0.0
a. SNF Grapple Attached to Crane b. Engage Cine SNF Assembly, (12 min. per assembly, 112 min. per assembly).	4h0ly) 250	250		2 Operators	20	0.5	0.0	0.0 25.0
SNF Grappie Attached to Crane Brigage Cris SNF Assembly, (12 min. per assembly).	250 70	250 70	- :	<u> </u>			0.0 4.2 1.2	0.0 25.0 7.0
a. SNF Grapple Attached to Crane b. Engage Cine SNF Assembly, (12 min. per assembly, 112 min. per assembly).	4h0ly) 250	250	- :	2 Operators	20	0.5	0.0	_
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per assibil). Time for cost c. Load SNF into cost Total	250 70	250 70	- :	21Operators 21Operators	20 20	0.5 0.5	0.0 4.2 1.2 5.6	0.0 25.0 7.0 33.0
a. SNF Grapple Attached to Crane b. Engage Crie SNF Assembly, (12 min. per assibil). Time for cask c. Load SNF into cask Total 11. Prep MESC/litarister from pool	250 70 330	250 70 330		2 Operators 2 Operators : casume pool bacgrou	20 20 and dose	0.5 0.5	0.0 4.2 1.2 6.6	0.0 25.0 7.0 33.0 bkod
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per assibil). Time for cost c. Load SNF into cost Total	250 70	250 70 330		2l Operators 2l Operators :	20 20 and dose	0.5 0.5 0.3 mre	0.0 4.2 1.2 5.5 m/tv 0.0	0.0 25.0 7.0 33.0 bkpd
a. SNF Grapple Attached to Crane b. Engage Crie SNF Assembly, (12 min. per assibil). Time for cask c. Load SNF into cask Total 11. Prep MESC/litarister from pool	250 70 330	250 70 390		2 Operators 2 Operators assume pool bacgrou 2 Operators 1 Ragman	20 20 20 nd does	0.5 0.5 0.3 mrs	0.0 4.2 1.2 5.5 m/rv 0.0	0.0 25.0 7.0 33.0 bkod 0.5
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per assibil). Time for cask c. Load SNF into cask. Total 11. Prep MESC/liansier from pool a. Attach MESC Shelid Plug Lit Fidure to Crane	250 70 330	250 70 390 5 5		21Operators 21Operators assume pool bacgrou 21Operators 11Ragman 11Orane Operator	20 20 20 nd dose 2 10 20	0.5 0.5 0.3 mrs	0.0 4.2 1.2 5.5 m/tv 0.0	0.0 25.0 7.0 33.0 bkod 0.0
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per asseb1, Time for cask c. Load SNF into cask Total 11. Prep MESC/leansier from pool a. Attach MESC Shield Plug Ut Fishure to Crane b. Install MESC Shield Plug	250 70 330 5	250 701 390 5 5 5		21Operators 21Operators - assume pool bacgrou 21Operators 11Rogman 11Crane Operator 01Remote	20 20 20 10 20 0	0.5 0.5 0.3 mrs	0.0 4.2 1.2 \$.6 m/hy 0.0 0.0 0.0	0.0 25.0 7.0 33.0 bkgd 0.5 0.3
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per assibil). Time for cask c. Load SNF into cask. Total 11. Prep MESC/liansier from pool a. Attach MESC Shelid Plug Lit Fidure to Crane	250 70 330	250 70 390 5 5		2iOperators 2iOperators	20 20 20 10 20 0	0.5i 0.5 0.5 0.0 0.0 0.0	0.0 4.2 1.2 5.5 m/hr 0.0 0.0 0.0	0.0 25.0 7.0 33.0 bkod 0.5 0.3 0.0
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per assibil. Time for cask c. Load SNF into cask Total 11. Prep MESC/leansier from pool a. Attach MESC Shield Plug Lit Fishure to Crane b. Install MESC Shield Plug	250 70 330 5	250 70 330 5 5 5 20		2(Operators 2(Operators 2(Operators 2(Operators 1)Ragman 1(Care Operator 0)Remote 1(Operator 1)Ragman	20 20 20 10 20 0 30 30	0.5 0.5 0.3 mrs	0.0 4.2 1.2 \$.6 m/hy 0.0 0.0 0.0	0.0 25.0 7.0 33.0 bkpd 0.5 0.1 0.1 0.1
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per assebit. Time for calk c. Load SNF into calk lotal 11. Prep MESC/fransfer from pool a. Attach MESC Shelid Plug Ut Fixture to Crane b. Install MESC Shelid Plug c. Engage Yate to Calk	330 330 5 20 5	250 70 330 55 5 5 5 5 5 5 5		caeume pool bacgrou 2!Operators caeume pool bacgrou 2!Operators 1!Ragman 1!Crane Operator 0!Remote 1!Operator 1!Ragman	20 20 20 10 20 0 30 30	0.5 0.5 0.3 mrs	0.0 4.2 1.2 5.5 em/rv 0.0 0.0 0.0 0.0 0.0	0.0 25.0 7.0 33.0 0.3 0.3 0.3 0.3 0.3
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per asseb 1, 1 me for calk c. Load SNF into calk Total 11. Prep MESC/transfer from pool a. Attach MESC Shelid Plug Lit Findure to Crane b. Install MESC Shelid Plug	250 70 330 5	250 70 330 55 5 5 5 5 5 5 5 5		2 Operators 2 (Operators 2 (Operators 1 Ragman 1 (Crane Operator 0 (Remote 1 (Operator 2 (Operator 2 (Operator)	20 20 20 20 20 20 20 0 30 30 40	0.5 0.5 0.5 0.3 mrs 0 0 0 0 0	0.0 4.2 1.2 5.5 9m/hr 0.0 0.0 0.0 0.0 0.0	0.0 25.0 7.0 33.0 0.3 0.3 0.3 0.3 0.3 0.3
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per assibil. Time for cask c. Load SNF into cask Total 11. Prep MESC/Itansier from pool a. Attach MESC Shelid Plug Lit Fedure to Crane b. Install MESC Shelid Plug c. Engage Yole to Cask d. Litt MESC/Cask to Pool Surface	5- 200 5- 5- 5- 5- 5- 5-	250 70 330 5 5 5 5 20 5 5 5 5		21Operators 21Operators 21Operators 21Operators 11Ragman 11Crane Operator 11Ragman 11Ragman 11Ragman 11Ragman 11Crane Operator 21Operator 21Operator	20 20 20 20 10 20 0 30 30 40 10	0.5 0.5 0.5 0.0 0 0 0 0 0 0	0.0 4.2 1.2 5.5 0.0 0.0 0.0 0.0 0.0 0.0	0.0 25.0 7.0 33.0 0.3 0.3 0.3 0.3 0.3 0.3
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per assible. Time for calk c. Load SNF into calk Total 11. Prep MESC/Ranister from pool a. Attach MESC Shelid Plug Lit Fixture to Crane b. Install MESC Shelid Plug c. Engage Yole to Calk d. Un MESC/Calk to Pool Surface e. Install Shelid Plus Retainers	250 70: 330 5 20 5	250 701 330 5 5 5 5 20 5 5 5 5 5		2iOperators 2iOperators 2iOperators 2iOperators 1iRagman 1iCrane Operator 0iRemote 1iOperator 1iRagman 1iCrane Operator 2iOperator 1iCrane Operator 1iCrane Operator 1iCrane Operator	20 20 20 20 20 20 20 0 30 30 40	0.5 0.5 0.5 0.3 mrs 0 0 0 0 0	0.0 4.2 1.2 5.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 25.0 33.0 0.1 0.1 0.1 0.1 0.1 0.1 0.1
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per assebit. Time for calk c. Load SNF into calk lotal 11. Prep MESC/Idensier from pool a. Attach MESC Shelid Plug Ut Fixture to Crane b. Install MESC Shelid Plug c. Engage Yate to Calk d. Utt MESC/Calk to Pool Surface e. Install Shield Plug Retainers f. 18th MESC/Calk into Prep/Decon Area	5- 200 5- 5- 5- 5- 5- 5-	250 701 3300 5 5 5 5 5 5 5 5 5 5 5 5 5 5		2(Operators 2(Operators 2(Operators 2(Operators 1) Regman 1(Operator 1(Operator 1) Operator	20 20 20 10 20 0 30 30 40 10 20 20	0.5 0.5 0.5 0 0 0 0 0 0 0 0	0.0 4.2 1.2 5.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 25.0 7.0 33.0 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per asset b). Time for cask c. Load SNF Into cask. Total 11. Prep MESC/Transfer from pool a. Attach MESC Shelid Plug Lift Fidure to Crane b. Install MESC Shelid Plug c. Engage Yole to Cask d. Uift MESC/Cask to Pool Surface e. Install Shelid Plug Retainers 1. Lift MESC/Cask into Prep/Decon Asso. (use decon background dose rate)	250 700 330 5 20 5 5	250 700 \$50 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		2iOperators 2iOperators 2iOperators 2iOperators 1iRagman 1iCrane Operator 0iRemote 1iOperator 1iRagman 1iCrane Operator 2iOperator 1iCrane Operator 2iOperators 1iCrane Operator 2iOperators 1iCrane Operator 1iOperator	20 20 20 10 20 30 30 40 10 20	0.5i 0.5i 0.5i 0 0 0 0 0 0 0 0 0	0.0 4.2 1.2 5.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 25.0 7.0 33.0 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
a. SNF Grappie Attached to Crane b. Engage Cris SNF Assembly, (12 min. per asset b). Time for cask c. Load SNF Into cask. Total 11. Prep MESC/Ransser from pool a. Attach MESC Shelid Plug Lift Fixture to Crane b. Install MESC Shelid Plug c. Engage Yate to Cask d. Lift MESC/Cask to Pool Surface e. Install Shield Plug Retainers f. Lift MESC/Cask into Prep/Decon Asso.	250 70: 330 5 20 5	250 700 \$300 55 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		2iOperators 2iOperators 2iOperators 2iOperators 1iRagman 1iCrane Operator 1iRagman 1iCrane Operator 2iOperators 1iCrane Operator 1iCrane Operator 1iOperator 1iOperator 1iOperator 1iOperator 1iOperator 1iOperator 1iOperator	20 20 20 20 10 20 0 30 30 40 10 20 20 20 20 20 20 20 20 20 20 20 20 20	0.5 0.5 0.5 0.3 mve 0 0 0 0 0 0 0 0 0 0 0 0 0	0.0 4.2 1.2 5.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 25.0 7.0 33.0 0.2 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per assebit. Time for calk c. Load SNF into calk Total 11. Prep MESC/feasier from pool a. Attach MESC Shield Plug Ut Fidure to Crane b. Install MESC Shield Plug Ut Fidure to Crane d. Un MESC/Calk to Pool Surface e. Install Shield Plug Retainers 1. Uth MESC/Calk into Prep/Decon Area (use decon background dose rate)	250 700 330 5 20 5 5	250 701 \$30 \$30 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		2iOperators 2iOperators 2iOperators 2iOperators 2iOperators 1iRagman 1iCrane Operator 1iRagman 1iCrane Operator 2iOperators 1iCrane Operator 2iOperators 1iCrane Operator 1iCrane Operator 1iCrane Operator 1iCrane Operator	20 20 20 10 20 0 30 30 40 10 20 20 10 20 20	0.5 0.5 0.5 0.3 mve 0 0 0 0 0 0 0 0 0 0 0 0 0	0.0 4.2 1.2 5.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 25.0 7.0 33.6 0.2 0.3 0.3 0.3 0.3 0.3 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9
a. SNF Grappie Attached to Crane b. Engage Citie SNF Assembly, (12 min. per assibil. Time for calk c. Load SNF into calk Total 11. Prep MESC/Ransker from pool a. Attach MESC Shield Plug bit Fedure to Crane b. Install MESC Shield Plug bit Fedure to Crane c. Engage Yote to Calk d. Ulti MESC/Calk to Pool Surface e. Install Shield Plug Retainen f. Lift MESC/Calk into Prep/Decon Area (use decon background dose rate) g. Disengage Yoke from Calk	250 700 330 5 20 5 10 30	250 701 \$300 \$5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		2iOperators 2iOperators 2iOperators 2iOperators 1iRagman 1iCrane Operator 1iRagman 1iCrane Operator 2iOperator 1iCrane Operator 2iOperator 1iCrane Operator 1iCrane Operator 1iCrane Operator 1iCrane Operator 1iCrane Operator 1iOperator 1iOperator 1iOperator	20 20 20 10 20 0 30 30 40 10 20 2 10 20 2	0.5 0.5 0.5 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.0 4.2 1.2 5.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 25.0 33.6 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0
a. SNF Grappie Attached to Crane b. Engage Cris SNF Assembly, (12 min. per assist). Time for cask c. Load SNF Into cask. Total 11. Prep MESC/Transfer from pool a. Attach MESC Shelid Plug Lift Fixture to Crane b. Install MESC Shelid Plug c. Engage Yole to Cask d. Lift MESC/Cask to Pool Surface e. Install Shelid Plug Retainers f. Lift MESC/Cask into Prep/Decon Asso (use decon background dose rate) g. Disengage Yoke from Cask h. Remove Sheld Plug Retainers	250 700 3300 5 20 5 5 10 300	250 700 350 55 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		2(Operators 2(Operators 2(Operators 2(Operators 1) Regman 1) Operator 0(Remote 1) Operator 1) Regman 1) Operator 1) Operator 2(Operators 1) Operator	20 20 20 10 20 0 30 30 40 10 20 20 10 20 20	0.5 0.5 0.5 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.0 4.2 1.2 8.6 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	0.0 25.0 7.0 33.0 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per assembly, 12 min. per assembly, 12 min. per assembly in the cask c. Load SNF into cask Total 11. Prep MESC/litansiler from pool a. Attach MESC Shield Plug Lit Ridure to Crane b. Install MESC Shield Plug c. Engage Yate to Cask d. Lith MESC/Cask to Pool Surface e. Install Shield Plug Retainers f. Lith MESC/Cask into Prep/Decon Asso (use decon brackground dose rate) g. Disengage Yake from Cask	250 700 330 5 20 5 10 30	250 700 300 55 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		2iOperators 2iOperators 2iOperators 2iOperators 2iOperators 1iRagman 1iCrane Operator 1iRagman 1iCrane Operator 2iOperators 1iCrane Operator 2iOperators 1iCrane Operator 1iOperator 1iOperator 1iOperator 1iOperator	20 20 20 10 20 30 30 40 10 20 2 10 20 20 20 10	0.5 0.5 0.5 0.0 0 0 0 0 0 0 0 0 0 0 0 0	0.0 4.2 1.2 \$.\$ 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 25.0 7.0 33.0 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per ass b1. Time for calk c. Load SNF Into calk. Total 11. Prep MESC/Ranster from pool a. Attach MESC Shelid Plug Lift Fidure to Crane b. Install MESC Shelid Plug Lift Fidure to Crane c. Engage Yole to Calk d. Lift MESC/Calk to Pool Surface e. Install Shelid Plug Retainers 1. Lift MESC/Calk into Prep/Decon Asso. (use decon brackground dose rate) g. Disengage Yoke from Calk h. Remove Shelid Plug Retainers i. Decon MESC/Calk and Yoke	250 700 330 5 5 10 30 120	250 701 \$300 \$300 \$5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		2iOperators 2iOperators 2iOperators 2iOperators 2iOperators 1iRagman 1iCrane Operator 1iRagman 1iCrane Operator 2iOperators 1iCrane Operator 1iOperator	20 20 20 10 20 0 30 40 10 20 20 20 20 20 20 20 20 20 20 20 20 20	0.5 0.5 0.5 0.5 0.0 0.0 0.0 0.0 0.0 0.0	0.0 4.2 1.2 5.5 m/hr 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	0.0 25.0 7.0 33.0 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per assi b1. Time for cask c. Load SNF into cask Total 11. Prep MESC/Tiansler from pool a. Attach MESC Shield Plug Lit Fedure to Crane b. Install MESC Shield Plug Lit Fedure to Crane c. Engage Yole to Cask d. Un MESC/Cask hip Pool Surface e. Install Shield Plug Retainers f. Lin MESC/Cask into Prep/Decon Asso (use decon background dose rate) g. Disengage Yole from Cask h. Remove Shield Plug Retainers L. Decon MESC/Cask and Yoke i. Hook Up Dran Ecupment	250 700 330 5 5 5 10 30 120	250 700 \$300 \$300 \$5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		2iOperators 2iOperators 2iOperators 2iOperators 2iOperators 1iRagman 1iCrane Operator 1iCrane Operator 2iOperators 1iCrane Operator 2iOperator 1iCrane Operator 1iOperator	20 20 20 20 20 00 30 30 40 20 20 20 20 20 20 20 20 20 20 20 20 20	0.5 0.5 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 4.2 1.2 5.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 25.0 7.0 33.0 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per assembly, 12 min. per assembly in the cask c. Load SNF into cask Total 11. Prep MESC/Standler from pool a. Attach MESC Shield Plug Lit Fedure to Crane b. Install MESC Shield Plug c. Engage Yole to Cask d. Litt MESC/Cask to Pool Surface e. Install Shield Plug Retainers f. Litt MESC/Cask into Prep/Decon Asso (use decon background dose rate) g. Disengage Yoke from Cask h. Remove Shield Plug Retainers L. Decon MESC/Cask and Yoke i. Hook Up Dran Ecupment k. Partially Dran MESC and Annulus	250 700 330 5 20 5 10 30 120	250 701 \$300 \$5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		2iOperators 2iOperators 2iOperators 2iOperators 2iOperators 1iRagman 1iCrane Operator 1iCoperator 1iCrane Operator 2iOperator 1iCrane Operator 2iOperator 1iCrane Operator 1iCrane Operator 1iCrane Operator 1iOperator	20 20 20 10 20 0 30 30 40 20 2 10 20 20 10 20 20 10 20 20 10 20 20 10 20 10 20 10 10 10 10 10 10 10 10 10 10 10 10 10	0.5 0.5 0.5 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.0 4.2 1.2 5.6 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	0.0 25.0 7.0 33.9 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per asset b). Time for cask c. Load SNF into cask. Total 11. Prep MESC/Ranster from pool a. Affach MESC Shelid Plug Lift Fixture to Crane b. Install MESC Shelid Plug Lift Fixture to Crane c. Engage Yole to Cask d. Lift MESC/Cask to Pool Surface e. Install Shelid Plug Retainers f. Lift MESC/Cask into Prep/Decon Asso (use decon bioologround dose rate) g. Disengage Yoke from Cask h. Remove Shield Plug Retainers L Decon MESC/Cask and Yoke j. Hook Up Dran Equipment k. Partially Dran MESC and Annulus L. Remove Annulus Seof	250 700 3300 5 5 100 300 5 120 120 100 200 110	250 700 350 55 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		icoperators icoperators icoperators icoperators icoperators ilRagman ilRagman ilCrane Operator ilRagman ilCrane Operator	20 20 20 10 20 0 30 30 40 10 20 2 10 20 2 10 20 20 10 20 20 10 20 20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	0.5 0.5 0.5 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.0 4.2 1.2 8.6 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	0.0 25.0 7.0 33.0 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
a. SNF Grappie Attached to Crane b. Engage Crie SNF Assembly, (12 min. per assembly, 12 min. per assembly in the cask c. Load SNF into cask Total 11. Prep MESC/Standler from pool a. Attach MESC Shield Plug Lit Fedure to Crane b. Install MESC Shield Plug c. Engage Yole to Cask d. Litt MESC/Cask to Pool Surface e. Install Shield Plug Retainers f. Litt MESC/Cask into Prep/Decon Asso (use decon background dose rate) g. Disengage Yoke from Cask h. Remove Shield Plug Retainers L. Decon MESC/Cask and Yoke i. Hook Up Dran Ecupment k. Partially Dran MESC and Annulus	250 700 330 5 20 5 10 30 120	250 700 350 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		2iOperators 2iOperators 2iOperators 2iOperators 2iOperators 1iRagman 1iCrane Operator 1iCoperator 1iCrane Operator 2iOperator 1iCrane Operator 2iOperator 1iCrane Operator 1iCrane Operator 1iCrane Operator 1iOperator	20 20 20 10 20 0 30 30 40 20 2 10 20 20 10 20 20 10 20 20 10 20 20 10 20 10 20 10 10 10 10 10 10 10 10 10 10 10 10 10	0.5 0.5 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 4.2 1.2 \$.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	0.0 25.0 7.0 33.0 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3

Table A1-1. Utilities-Reference (continued)

					20	0.5	0.1	O.
		10		Crane Operator	~~~	뻐	90	a.
o, Inner Lid Weld	1000	- 0		Remote	- 2	220	73.3	- 0
p1. Perform NDE on Weld	30	20		QA Welder	. 2	220	73.3	0.
Remove Welding Equipment	20	20		Welder		0.5	- (33)	0.
		10		Crane Operator	20			- 0
, Drain, Dry, and inert MPC	350	10		Operator	2	220	36.7	
		350		Operator	10:	8.7	50.8	5.
Remove Drain, Dry, and Inerling Equipment	10	10	1	Operator	2	220	36.7	0.
Perform Leak Tests on Seal Weld	20	20		Operator	2	37	123	0.
Penomi Leck less of Section	90	90		Welder	2	220	330.0	1.
Weld Valve Cover Rates	20	10		Operator	- 2	97	16.2	0.
. Place MESC Outer Ud	- 20				10	8.7	1.5	ā
		10		Rogman	20	0.5	0.1	- c
	↓	10		Crane Operator			48.5	
v. Set Up Remote Welding Equipment	45	30		Welder	2:	97		0.
		10	1	Crane Operator	20	0.5	0.1	0.
Weld MESC Outer Lid	1000	0	0	Remote	0	0	0.0	0
1. Perform NDT on Weld	30	20	1	QA Welder	2	97	32.3	Q
Remove Arrulus Weld Protection	10	10	1	Operator	2	97	16.2	0.
	10	10		Operator	2	97	16.2	ā
Piace Transfer Cask Lid					10	8.7	15	Ō.
		10		Ragman		0.5	0.1	- 0
		10		Crane Operator	20			
ara. Decon Cask	30	30		Operators	2	59	59.0	_1
		30	1	Crane Operator	20	0.5	0.3	Q.
bb. Perform HP Survey	45	20		Radiation Protection	2	59	39.3	0
cc. Secure Transfer Cask Batted Lid	30	30		Operators	2	97	ن.97	1.
	3075	1,150			: :		1367.1	25
Total	~/0	.,				_		
								
12. Prep MESC/fransler-overpack				Casume crone creato	cicero e	27 C		
for ISPSI						0	0.0	-0
c. Open Staging Area Door	5	0		Operator	0			
b. Move On-Ste PM and Transporter to Staging A	10	10		Prime Mover Operator		0	0.0	0
		10	1	Transporter Operator	. 15:	0	0.0	_0
c. Unhitch On-Site PM	5	5	1	Prime Mover Operator	15	0	0.0	0
C. UTRICTOVALETA	10	10		Operator	2	37	6.2	0
d. Engage Yake to MESC/Cask		10		Rooman	10	8.7	1.5	0
		10		Crane Operator	20	0.5	0.11	0
					0	0	0.0	ō
d1. Close Staging Area Door, simultaneously w		0		Operator	10:	8.7	13.1	-
Place MESC/Cask on Transporter	45	45		Operators				ö
		45		Crane Operator	20	0.5	0.4	
f, Perform Release HP Survey	60	30	2	Radiation Protection	2'	50	59.0	0
g. Install Cask Restraints	60	60	2	Operators	2_	32	64.0	0
h. Open Prep Area Door	5	0	1	Operator	0	0	0.0	0
i. Prepare Transfer Papers	10	0		Operator	0	0	0.0	0
j Move MESC/Cark Outside Protected Area	10	10		Prime Mover Operator	15	0.5	0.1	0
, Move Mesc/Com Conside Profession Alec	60			Operators	10	8.7	8.7	0
k. Move MESC/Cosk to ISFSI	- 80	30		Prime Mover Operator		0.5	0.3	0
	l	30		LISTING MOSE ODDIOR	15			
		-			15_			O
		30	1	Crane Operator	20	0.5	0.3	
		30	1	Crane Operator Radiation Protection			0.3 4.4	0
Total	280		1		20	0.5	0.3	0
Total	280	30	1		20	0.5	0.3 4.4	0
	280	30	1		20	0.5	0.3 4.4	0
13. Transfer MESC from Transfer-	280	30	1		20 10	0.5 8.7	0.3 4.4 157.8	1
13. Transfer MESC from Transfer- Oversack to ISFSI		30 365		Radiation Protection	20 10	0.5 8.7 70	0.3 4.4 157.8	1
13. Transfer MESC from Transfer-	280	30 345 30		Radiation Protection	20 10 10	0.5 8.7	0.3 4.4 157.8	0 1
13. Transfer MESC from Transfer- Oversack to ISFSI		30 365 365 30 60	1	Radiation Protection assume ISR backgroun Operators Preme Mover Operator	20 10 10 d dose 2 15	0.5 8.7 70 0.5	0.3 4.4 157.8	2 2
13. Transfer MESC from Transfer- Oversack to ISFSI		30 365 30 60 60	2	Radiation Protection assume ISR backgroun Operators Prime Mover Operator Crane Operator	20 10 10 d dose 2 15 20	0.5 8.7 70	0.3 4.4 157.8 70.0 0.5	2 2 2
13. Transfer MESC from Transfer- Overpack to ISFSI a, Prepare Cask for MESC Transfer	60	30 348 30 30 60 60	2	Radiation Protection assume ISR backgroun Operators Prime Mover Operator Crane Operator Radiation Protection	20 10 10 2 15 20 10	70 0.5 0.5 0.5 8.7	70.0 0.5 0.5 8.7	2 2 2
13. Transfer MESC from Transfer- Overpack to ISFSI a. Prepare Cask for MESC Transfer al. Open ISFSI Storage Door, simultaneously w	60	30 348 30 60 60 20	2	Radiation Protection assume ISR backgroun Operators Prime Mover Operator Crane Operator Radiation Protection Operator	20 10 10 2 15 20 10	70 0.5 0.5 0.5 8.7 70	70.0 0.5 0.5 8.7 23.3	2 2 2 2
13. Transfer MESC from Transfer- Overpack to ISFSI a, Prepare Cask for MESC Transfer	60	30 365 30 60 60 20 0	2	Radiation Protection assume ISR backgroun Operators Prime Mover Operator Crane Operator Radiation Protection Operator Prime Mover Operator	20 10 10 2 15 20 10 2	70 0.5 0.5 0.5 0.5 8.7 70	70.0 0.5 0.5 0.5 23.3	2 2 2 2 0
13. Transfer MESC from Transfer- Overpack to ISFSI a. Prepare Cask for MESC Transfer al. Open ISFSI Storage Door, simultaneously w	60	30 365 30 60 60 20 0	2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Radiation Protection assume ISRI backgroun Operators Prime Mover Operator Crane Operator Radiation Protection Operator Prime Mover Operator Prime Mover Operator Operator	20 10 10 2 15 20 10 2 15 20	70 0.5 0.5 0.5 8.7 70 0.5 0.5	70.0 0.5 0.5 8.7 23.3 0.0	2 2 2 2 0
13. Transfer MESC from Transfer- Overpack to ISPSI a. Prepare Cask for MESC Transfer a1. Open ISPSI Storage Door, simultaneously w Step a.	60	30 365 30 60 60 20 0	2	Radiation Protection assume ISR backgroun Operators Prime Mover Operator Radiation Protection Operator Operator Operator Operator Operator Operator Operator Operator	20 10 10 2 15 20 10 2 15 20	70 0.5 0.5 0.5 0.5 0.5 0.5 8.7	70.0 0.5 0.5 8.7 23.3 0.0 0.0	2 2 2 2 2 0 0
13. Transfer MESC from Transfer- Overgack to ISPSI a. Prepare Cask for MESC Transfer a1. Open SFSI Storage Door, simultaneously w Step a.	60	30 365 30 60 60 20 0 0		Radiation Protection assume ISR backgroun Operators Prime Mover Operator Radiation Protection Operator Operator Operator Operator Crane Operator Radiation Protection Operator Operator Radiation Protection Operator	20 10 10 2 15 20 10 2 15 20 10	70 0.5 0.5 0.5 0.5 0.5 0.5 8.7 70 0.5 8.7 8.7	70.0 0.5 0.5 0.5 0.5 0.0 0.0 0.0 0.0	2 2 2 2 2 2 0 0
13. Transfer MESC from Transfer- Overpack to ISFSI a. Prepare Cask for MESC Transfer al. Open ISFSI Storage Door, simultaneously w	60	30 345 30 60 60 20 0 0 0 30 60		Radiation Protection assume ISR backgroun Operators Prime Mover Operator Crane Operator Radiation Protection Operator Prime Mover Operator Prime Mover Operator Radiation Protection Coperator Radiation Protection Operators Prime Mover Operator	20 10 10 2 15 20 10 2 15 20 10 10 10	70 0.5 8.7 70 0.5 0.5 8.7 70 0.5 8.7 8.7 0.5	70.0 0.5 0.5 0.5 2.3 0.0 0.0 0.0 0.5	2 2 2 2 2 2 0 0
13. Transfer MESC from Transfer- Overgack to ISPSI a. Prepare Cask for MESC Transfer a1. Open SFSI Storage Door, simultaneously w Step a.	60	30 365 30 60 60 20 0 0		Radiation Protection assume ISR backgroun Operators Prime Mover Operator Crane Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Crane Operator Radiation Protection Operator Radiation Protection Operator Radiation Protection Crane Operator Radiation Protection Coperators Prime Mover Operator Crane Operator	20 10 10 2 15 20 10 2 15 20 10 2 15 20 10 2 15 20 10 2 15 20 10 2 2 15 20 10 10 10 10 10 10 10 10 10 10 10 10 10	70 0.5 0.5 0.5 0.5 8.7 70 0.5 8.7 0.5 8.7 0.5 0.5	70.0 0.5 0.5 8.7 23.3 0.0 0.0 8.7 0.5	
13. Transfer MESC from Transfer- Overgack to ISPSI a. Prepare Cask for MESC Transfer a1. Open SFSI Storage Door, simultaneously w Step a.	60	30 345 30 60 60 20 0 0 0 30 60		Radiation Protection assume ISR backgroun Operators Prime Mover Operator Crane Operator Radiation Protection Operator Prime Mover Operator Prime Mover Operator Radiation Protection Coperator Radiation Protection Operators Prime Mover Operator	20 10 10 2 15 20 10 2 15 20 10 2 15 20 10 10 10 10 10 10 10 10 10 10 10 10 10	0.5 8.7 70 0.5 0.5 8.7 70 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	70.0 0.5 0.5 0.5 23.3 0.0 0.0 0.0 0.0 8.7 0.5	2 2 2 2 2 2 0 0 0
13. Transfer MESC from Transfer- Overpack to ISPSI a. Prepare Cask for MESC fransfer a1. Open ISPSI Starage Door, simultaneously w Step a. b. Align Cask With ISPSI	60	30 345 30 60 60 20 0 0 0 0 60 60 60 60 60 60 60 60 60 60		Radiation Protection assume ISR backgroun Operators Prime Mover Operator Crane Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Crane Operator Radiation Protection Operator Radiation Protection Operator Radiation Protection Crane Operator Radiation Protection Coperators Prime Mover Operator Crane Operator	20 10 10 2 15 20 10 2 15 20 10 2 15 20 10 2 15 20 10 2 15 20 10 2 2 15 20 10 10 10 10 10 10 10 10 10 10 10 10 10	70 0.5 0.5 0.5 0.5 8.7 70 0.5 8.7 0.5 8.7 0.5 0.5	70.0 0.5 0.5 8.7 23.3 0.0 0.0 8.7 0.5	2 2 2 2 2 2 2 0 0 0 0
13. Transfer MESC from Transfer- Overpack to ISPSI a. Prepare Cask for MESC Transfer a1. Open ISPSI Storage Door, simultaneously w Step a.	60	30 345 30 60 60 0 0 0 0 0 0 0 0 60 60 60 60 60 6		Radiation Protection assume ISFI backgroun Operators Prime Mover Operator Crane Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Radiation Protection Radiation Protection	20 10 2 15 20 10 2 15 20 10 10 10 10 15 20 10	0.5 8.7 70 0.5 0.5 8.7 70 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	70.0 0.5 0.5 0.5 23.3 0.0 0.0 0.0 0.0 8.7 0.5	2 2 2 2 2 2 2 0 0 0 0
13. Transfer MESC from Transfer- Overpack to ISPSI a. Prepare Cask for MESC fransfer a1. Open ISPSI Starage Door, simultaneously w Step a. b. Align Cask With ISPSI	60	30 345 30 60 60 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		Radiation Protection assume ISR backgroun Operators Prime Mover Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Operator Radiation Protection Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operators	20 10 2 15 20 10 2 15 20 10 10 10 10 15 20 10	0.5 8.7 70 0.5 0.5 8.7 70 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5	0.3 4.4 157.8 70.0 0.5 0.5 8.7 23.3 0.0 0.0 0.0 8.7 0.5 5.5 8.7 0.5 0.5	
13. Transfer MESC from Transfer- Overpack to ISPSI a. Prepare Cask for MESC fransfer a1. Open ISPSI Starage Door, simultaneously w Step a. b. Align Cask With ISPSI	60	30 345 30 60 60 20 0 0 0 0 0 60 60 60 60 60 60 60 60 60 6		Radiation Protection assume ISR backgroun Operators Prime Mover Operator Crane Operator Prime Mover Operator Prime Mover Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operators Prime Mover Operator Crane Operator Crane Operator Crane Operator Crane Operator	20 10 2 2 15 20 10 2 15 20 10 10 15 20 10	0.5 8.7 70 0.5 0.5 8.7 0.5 0.5 8.7 0.5 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.3 4.4 157.8 70.0 0.5 8.7 23.3 0.0 0.0 8.7 0.5 6.5 6.7 70.0	
13. Transfer MESC from Transfer- Overpack to ISPSI a. Prepare Cask for MESC fransfer a1. Open ISPSI Starage Door, simultaneously w Step a. b. Align Cask With ISPSI c. Prepare Transfer Equipment	60	30 345 30 60 60 0 0 0 0 0 0 0 60 60 60 60 60 60		Radiation Protection assume ISR backgroun Operators Prime Mover Operator Crane Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Operator Radiation Protection Coperator Radiation Protection Operator Radiation Protection	20 10 2 15 20 15 20 10 10 15 20 10 10 15 20 10 20 10	0.5 8.7 70 0.5 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.3 4.4 157.8 70.0 0.5 0.5 8.7 23.3 0.0 0.0 0.0 0.5 8.7 7.0 0.5 0.5 8.7 7.0 0.5 8.7 70.0 0.5 8.7	
13. Transfer MESC from Transfer- Overpack to ISPSI a. Prepare Cask for MESC fransfer a1. Open ISPSI Starage Door, simultaneously w Step a. b. Align Cask With ISPSI	60	30 345 30 60 60 0 0 0 0 0 0 0 60 60 60 60 60 60		Radiation Protection assume ISR backgroun Operators Prime Mover Operator Crane Operator Prime Mover Operator Prime Mover Operator Crane Operator Radiation Protection Operators Prime Mover Operator Crane Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operators	20 10 2 15 20 10 2 15 20 10 10 10 10 2 2 15 20 10 10 10 10 10 10 10 10 10 10 10 10 10	0.5 8.7 70 0.5 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 8.7 0.5 8.7 8.7 0.5 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7	0.3 4.4 157.8 70.0 0.5 0.5 8.7 22.3 0.0 0.0 0.0 0.5 8.7 70.0 0.5 8.7 70.0	
13. Transfer MESC from Transfer- Overpack to ISPSI a. Prepare Cask for MESC fransfer a1. Open ISPSI Starage Door, simultaneously w Step a. b. Align Cask With ISPSI c. Prepare Transfer Equipment	60	30 345 30 60 60 0 0 0 0 0 0 0 60 60 60 60 60 60		Radiation Protection assume ISR backgroun Operators Prime Mover Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Crane Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operators	20 10 2 2 15 20 10 2 15 20 10 10 10 15 20 10 10 15 20 10 10 10 10 10 10 10 10 10 10 10 10 10	0.5 8.7 70 0.5 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.3 4.4 157.8 70.0 0.5 8.7 23.3 0.0 0.0 8.7 0.5 0.5 0.5 0.5 8.7 70.0 0.5 8.7 70.0	
13. Transfer MESC from Transfer- Overpack to ISPSI a. Prepare Cask for MESC fransfer a1. Open ISPSI Starage Door, simultaneously w Step a. b. Align Cask With ISPSI c. Prepare Transfer Equipment	60	30 345 50 60 0 0 0 0 0 0 0 0 60 60 60 60 60 60 6		Radiation Protection assume ISR backgroun Operators Prime Mover Operator Radiation Protection Operator Radiation Protection Operator Radiation Protection Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Operator	20 10 2 2 15 20 10 2 15 20 10 10 10 15 20 10 10 15 20 10 10 15 20 10 10 10 10 10 10 10 10 10 10 10 10 10	700 0.5 8.7 700 0.5 8.7 700 0.5 8.7 700 0.5 8.7 700 0.5 8.7 70 8.7 70 8.7 8.7 8 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8	0.3 4.4 157.8 70.0 0.5 0.5 0.0 0.0 0.0 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	
13. Transfer MESC from Transfer- Overpack to ISPSI a. Prepare Cask for MESC fransfer a1. Open ISPSI Starage Door, simultaneously w Step a. b. Align Cask With ISPSI c. Prepare Transfer Equipment	60	30 345 30 60 60 0 0 0 0 0 0 0 60 60 60 60 60 60		Radiation Protection assume ISR backgroun Operators Prime Mover Operator Crane Operator Prime Mover Operator Prime Mover Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Crane Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operators Radiation Protection Operators Radiation Protection Operators Radiation Protection	20 10 2 15 20 10 2 15 20 10 10 15 20 10 10 15 20 10 10 2 15 20 10 10 10 10 10 10 10 10 10 10 10 10 10	0.5 8.7 70 0.5 0.5 8.7 70 8.7 70 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7	0.3 4.4 157.8 70.0 0.5 0.5 8.7 23.3 0.0 0.0 0.0 8.7 70.5 0.5 8.7 70.0 0.5 8.7 70.0 0.5 0.5 8.7 70.0 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	
13. Transfer MESC from Transfer- Overpack to ISPSI a. Prepare Cask for MESC Transfer a1. Open ISPSI Storage Door, simultaneously w Shep a. b. Align Cask With ISPSI c. Prepare Transfer Equipment d. Transfer MESC From Cask to ISPSI	60	30 345 30 60 60 20 0 0 0 0 0 60 60 60 60 60 60 60 60 60 6		Radiation Protection assume SRI backgroun Operators Prime Mover Operator Crane Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Radiation Protection Operator Radiation Protection	20 10 10 2 15 20 10 2 15 20 10 10 15 20 10 10 2 15 20 10 10 10 10 10 10 10 10 10 10 10 10 10	0.5 8.7 70 0.5 0.5 8.7 70 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.3 4.4 157.8 70.0 0.5 0.5 8.7 223.3 0.0 0.0 0.0 0.5 8.7 70.0 8.7 70.0 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7	
13. Transfer MESC from Transfer- Overpack to ISPSI a. Prepare Cask for MESC fransfer a1. Open ISPSI Starage Door, simultaneously w Step a. b. Align Cask With ISPSI c. Prepare Transfer Equipment	60	30 345 30 60 60 0 0 0 0 0 0 0 60 60 60 60 60 60		Radiation Protection assume ISR backgroun Operators Prime Mover Operator Crane Operator Prime Mover Operator Prime Mover Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Crane Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operators Radiation Protection Operators Radiation Protection Operators Radiation Protection	20 10 10 2 15 20 10 2 15 20 10 10 15 20 10 10 2 15 20 10 10 10 10 10 10 10 10 10 10 10 10 10	0.5 8.7 70 0.5 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7	0.3 4.4 157.8 70.0 0.5 8.7 23.3 0.0 0.0 0.0 8.7 0.5 0.5 8.7 70.0 0.5 8.7 70.0 0.5 8.7 70.0 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	
13. Transfer MESC from Transfer- Overpack to ISPSI a. Prepare Cask for MESC fransfer a1. Open ISPSI Storage Door, simultaneously w Shep a. b. Align Cask With ISPSI c. Prepare Transfer Equipment d. Transfer MESC From Cask to ISPSI	60	30 345 30 60 60 0 0 0 0 0 0 0 0 60 60 60 60 60 6		Radiation Protection assume SRI backgroun Operators Prime Mover Operator Crane Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Radiation Protection Operator Radiation Protection	20 10 10 2 15 20 10 2 15 20 10 10 15 20 10 10 2 15 20 10 10 10 10 10 10 10 10 10 10 10 10 10	0.5 8.7 70 0.5 0.5 8.7 70 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.3 4.4 157.8 70.0 0.5 8.7 23.3 0.0 0.0 0.0 8.7 0.5 5.7 70.0 0.5 8.7 0.5 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	
13. Transfer MESC from Transfer- Overpack to ISFSI a. Prepare Cask for MESC fransfer al. Open SFSI Storage Door, simultaneously w Step a. b. Align Cask With ISFSI c. Prepare Transfer Equipment d. Transfer MESC From Cask to ISFSI	60	30 345 30 60 60 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		Radiation Protection assume SRI backgroun Operators Prime Mover Operator Crane Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Crane Operator Radiation Protection Operators Prime Mover Operator Radiation Protection	20 10 2 2 15 20 10 2 15 20 10 10 15 20 10 10 15 20 10 10 15 20 10 10 10 10 10 10 10 10 10 10 10 10 10	0.5 8.7 70 0.5 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7	0.3 4.4 157.8 70.0 0.5 8.7 23.3 0.0 0.0 0.0 8.7 0.5 0.5 8.7 70.0 0.5 8.7 70.0 0.5 8.7 70.0 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	222222222222222222222222222222222222222
13. Transfer MESC from Transfer Overpack to ISFSI a. Prepare Cask for MESC fransfer a1. Open ISFSI Starage Door, simultaneously w Step a. b. Align Cask With ISFSI c. Prepare Transfer Equipment d. Transfer MESC from Cask to ISFSI e. Close ISFSI Starage Door	60	30 345 30 60 60 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		Radiation Protection assume ISR backgroun Operators Prime Mover Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Operator Operator Radiation Protection Operator Operator Radiation Protection Operator Radiation Protection	20 10 2 2 15 20 10 2 15 20 10 10 15 20 10 10 15 20 10 10 15 20 10 10 15 20 10 10 10 10 10 10 10 10 10 10 10 10 10	0.5 8.7 70 0.5 0.5 8.7 70 8.7 70 8.70 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	0.3 4.4 157.8 70.0 0.5 8.7 23.3 0.0 0.0 8.7 70.0 0.5 8.7 70.0 0.5 8.7 70.0 0.5 8.7 70.0 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	222222222222222222222222222222222222222
13. Transfer MESC from Transfer- Overpack to ISFSI a. Prepare Cask for MESC fransfer al. Open SFSI Storage Door, simultaneously w Step a. b. Align Cask With ISFSI c. Prepare Transfer Equipment d. Transfer MESC From Cask to ISFSI	60	30 345 30 60 60 0 0 0 0 30 60 60 60 60 60 60 60 60 60 60 60 60 60		Radiation Protection assume ISR backgroun Operators Prime Mover Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Operator Operator Radiation Protection Operator Operator Radiation Protection Operator Radiation Protection	20 10 2 2 15 20 10 2 15 20 10 10 15 20 10 10 15 20 10 10 15 20 10 10 15 20 10 10 10 10 10 10 10 10 10 10 10 10 10	0.5 8.7 70 0.5 0.5 8.7 70 8.7 70 8.70 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	0.3 4.4 157.8 70.0 0.5 0.5 8.7 23.3 0.0 0.0 0.5 8.7 70.5 0.5 8.7 70.0 0.5 8.7 70.0 0.5 0.5 8.7 70.0 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	222222222222222222222222222222222222222

Table A1-1. Utilities-Reference (continued)

	T	(10)		Crane Operator	20	0.5	0.5	_ 2
		()()	1	Radiation Protection	10	8.7	8.7	- 2
Total	360	1,100				_	299.2	4
				<u> </u>	<u> </u>			
Transfer MESC born ISFSI to							\longrightarrow	
Transfer-overprick				casume ISP bookground				_
a. Prepare Calk for MESC Transfer	60	:10		Operators	2	<u> </u>	0.0	
		(10)		Prime Mover Operator	15	0	0.0	
		(10)		Crane Operator	20_	0	0.0	
		(10)		Radiation Protection	10	이	0.0	:
b. Align Cook with ISFS	40	:10	_	Operators ·	_2_	9	0.0	:
		(30)		Prime Mover Operator	15	0	0.0	:
		(10	1	Crane Operator .	20	0	0.0	:
		60	1	Radiation Protection	10	0	0.0	:
c. Open ISS Slorage Door	0	:20	1	Operators ·	2:	70	23.3	
		0	1	Prime Mover Operator	15	0.5	0.0	
		O		Crane Operator	20	0.5	0.0	
		O	1	Radiation Protection	10	8.7	0.0	. (
d. Prepare licinfer Equipment	60	:30	2	Operators	2	70	70.0	
471000000000000000000000000000000000000		450	1	Prime Mover Operator	15	0.5	0.5	_:
		(50)	1	Crane Operator	20:	0.5	0.5	
		(50		Radiation Protection	10:	8.7	8.7	- 6
e. Transfer MESC to Transfer Cask	30	:30	2	Operators	10	8.7	8.7	
0. 10 00 00 00		:30	1	Prime Mover Operator	15	0.5	0.3	
		30	1	Crane Operator :	20	0.5	0.3	
		30		Radiation Protection :	10.	8.7	4.4	
f. Close ISFS Storage Door	30	30	2	Operators	2	70	70.0	
r. Cook Statistical Park		30	1	Prime Mover Operator	15	0.5	0.3	
		30		Crane Operator	20	0.5	0.3	
		30		Radiation Protection	10	8.7	4.4	
a harded Cost Closs 20	55	55	2	Operators	2	70	128.3	
g. Install Cast Clasure		55		Prime Mover Operator	15	0.5	0.5	
		55		Crone Operator	20	0.5	0.5	
		55		Radiation Protection	10	8.7	8.0	
h. Prepare to Nove Off-Site Transportation Cask F	nom SF						0.0	
Yord	60	30	2	Operators	2	70	70.0	- :
100		60		Parne Mover Operator	15	0.5	0.5	- 1
		60		Crane Operator	20	0.5	0.5	- 2
		8		Radiation Protection	10	8.7	8.7	
	356	1,320					408.4	5
Total								
Prep MESC/Transfer from ISFSI for Pool				casume pool backgroun	d3me	m/n		
a. Move MSC/Cask to Stagging Area	60	30	2	Operators	10	8.7	8.7	
Q HOTOLOGIC		30	1	Prime Mover Operator	15	0.5	0.3	
		30	1	Crane Operator	20	0.5	0.3	
		30	1	Radiation Protection	10.	8.7	44	
b. Open Prep Ared Door	5	5	1	Operator	0	0	0.0	
c. Remove Crak Restraints	60	60		Operators	2	32	640	-
d. Remove MSC/Cask from Iromporter	45	45		Operators	10	8.7	13.1	
<u> </u>		45	1	Crane Operator	20	0.5	0.4	
d1. Close Staging Area Door, simultaneously w	1	45	1	Operator	D	0	0.0	
e, Install Call Lid Lifting Device	20	20		Operators	2	97	64.7	
U. 16:05 CO. 05:05	1	10	,	Rooman	10	8.7	1.5	
	1	10		Crane Operator	20	0.5	0.1	
1. Loceen/Remove Calit Ltd	 			Operators	2	97	145.5	
I. Development Country of the Countr	1	20		Ragman	10	8.7	2.9	
				Crane Operator	20	0.5	0.2	
	 	20	. 1			97	48.5	
as See the Devices Coffees for instant	45	_		Welder	2	_	0.1	
g, Set Up Remote Culting Equipment	45	30			20_	0.5	0.0	
		30 10		Crane Operator		0.5		
h, Cur Mesc lid	45 1000	30 10 0		Crane Operator Remote	20		16.2	
h, Cut MESC lid i. Remove Arrulus Culting Protection	1000	30 10 0		Crane Operator Remote Operator	20 0	0		
h, Cur Mesc lid	1000	30 10 0 10 20	(Crone Operator Remote Coperator Coperator	20 0 2	97	16.2	
h, Cut MESC lid i. Remove Arrulus Culting Protection	1000	30 10 0	(Crane Operator Remote Coperator Coperator Rogman	20 0 2 2	97 97	16.2 32.3	
h. Out MESC lid i. Remove Arrulus Outling Protection j. Remove MESC Outer Lid	1000	30 10 0 10 20 10		Crane Operator Remote Operator I Operator I Operator Regman Crane Operator	20 0 2 2 10	97 97 8.7	16.2 32.3 1.5	
h. Out MESC lid i. Remove Arrulus Outling Protection j. Remove MisC Outer Lid k. Install Arrulus Cutting Protection	1000 10 20	30 10 0 10 20 10 10		Crane Operator Remote Coperator Coperator Rogman	20 0 2 2 10 20	97 97 8.7 0.5	16.2 32.3 1.5 0.1	
h. Out MESC lid i. Remove Arrulus Outling Protection j. Remove MESC Outer Lid	1000	30 10 0 10 20 10 10		Crane Operator Remote Coperator Coperator Coperator Coperator Coperator Coperator Coperator Coperator	20 6 2 2 10 20 2	97 97 8.7 0.5 220	16.2 32.3 1.5 0.1 73.3 110.0	
h. Out MESC lid i. Remove Arrulus Outling Protection j. Remove MESC Outer Lid k. Install Arrulus Cutting Protection i. Install Remote Out Equipment	1000 10 20	30 10 0 10 20 10 10 10 30		Crane Operator Remote Coperator Coperator Ragman Coperator Coperator Coperator Coperator Coperator Coperator Coperator	20 0 2 2 10 20 2	0 97 97 8.7 0.5 220 220	16.2 32.3 1.5 0.1 73.3 110.0	
h. Cut MSSC lid i. Remove Arrulus Cutting Protection j. Remove MSSC Outer Lid k. Install Arrulus Cutting Protection L. Install Remote Cut Equipment m. Inner Lid Cut	10 20 10 45	30 10 0 10 20 10 10 10 30		Crane Operator Remote Coperator Coperator Coperator Ragman I Crane Operator Coperators Welder	20 0 2 2 10 20 2 2 2	0 97 97 8.7 0.5 220 220	16.2 32.3 1.5 0.1 73.3 110.0 0.1	
h. Out MESC lid i. Remove Arrulus Outling Protection j. Remove MESC Outer Lid k. Install Arrulus Cutting Protection i. Install Remote Out Equipment	1000 10 20	30 0 0 10 20 10 10 10 30 10		Crane Operator Remote Operator Operator Operator Regman Crane Operator Welder Operator Operator Welder Welder	20 0 2 2 10 20 2 2 2 2 20 0	0 97 97 8.7 0.5 220 220 0.5	16.2 32.3 1.5 0.1 73.3 110.0 0.1 0.0	
h. Cut MESC lid i. Remove Arrulus Culting Protection j. Remove MESC Outer Lid k. Install Arrulus Culting Protection i. Install Remote Cut Equipment m. Inner Lid Cut n. Remove Cutting Equipment	10000 10000 10000 45	30 10 0 10 20 10 10 10 30 10 0 20		Crane Operator Remote Operator Operator Operator Ragman Crane Operator Welder Operator	20 0 2 2 10 20 2 2 2 2 20 0	0 97 97 8.7 0.5 220 220 0.5 0	16.2 32.3 1.5 0.1 73.3 110.0 0.1 0.0 73.3	
h. Cut MESC (id i. Remove Arrubs Cutting Protection j. Remove MESC Outer Lid it. Install Arrubs Cutting Protection it. Install Remote Cut Equipment in. Inner Lid Cut iii. Remove Cutting Equipment o. RE Annulus with Demineralized Water	10000 10000 10000 45	30 10 0 10 20 10 10 10 30 10 20 20 10 30 30 30 30 30 30 30 30 30 30 30 30 30		Crane Operator Remote Operator Operator Operator Operator Regman Crane Operator Welder Crane Operator Remote Welder Welder Operator	20 0 2 2 10 20 2 2 2 2 2 2 2 2 2 2 2 2 2	0 97 97 8.7 0.5 220 220 0.5 0 220	16.2 32.3 1.5 0.1 73.3 110.0 0.1 0.0 73.3 0.1 59.0	
h. Cut MESC lid i. Remove Arrulus Cutting Protection j. Remove MESC Quer Lid k. Install Arrulus Cutting Protection L. Install Remote Cut Equipment m. Inner Lid Cut n. Remove Cutting Equipment o. Fill Annulus with Demineralized Water p. Install MESC Contamination Protection	100 20 100 20 100 20 20 20 20 20 20 20 20 20 20 20 20 2	30 10 0 10 20 10 10 10 30 10 20 20 30 30 30 30 30 30 30 30 30 30 30 30 30		Crane Operator Remote Operator Operator Operator Crane Operator Crane Operator Welder Crane Operator	20 0 2 2 10 20 2 2 20 0 2 2 20 2	0 97 97 8.7 0.5 220 220 0.5 0 220 0.5 59	16.2 32.3 1.5 0.1 73.3 110.0 0.1 0.0 73.3 0.1 59.0 220.0	
h. Cut MESC lid i. Remove Arrulus Cutting Protection j. Remove MESC Outer Lid k. Install Arrulus Cutting Protection L. Install Remote Cut Equipment m. Inner Lid Cut n. Remove Cutting Equipment o. Rill Annulus with Demineralized Water p. Install MESC Contamination Protection q. Connect Annulus Roat Hoses	100 20 100 20 20 20 20 20 20 20 20 20 20 20 20 2	30 10 0 10 10 10 10 30 10 10 20 30 30 30 30 30 30 30 55		Crane Operator Remote Operator Operator Operator Regman Crane Operator Welder Welder Crane Operator Welder Operator	20 0 2 2 10 20 2 2 20 0 2 2 20 2 2 2 2 2	0 97 97 8.7 0.5 220 220 0.5 0 220 0.5 59 220	16.2 32.3 1.5 0.1 73.3 110.0 0.1 0.0 73.3 0.1 59.0 220.0	
h. Cult MESC lid i. Remove Arrulus Culting Protection j. Remove MESC Outer Lid k. Install Arrulus Culting Protection L. Install Remote Cult Equipment m. Inner Lid Cult n. Remove Culting Equipment o. Rill Annulus with Demineralized Water p. Install MESC Contamination Protection q. Connect Annulus Roat Hoses 1. Rill MESC Water	10000 10000 10000 10000 45	30 10 10 20 10 10 10 10 20 20 20 30 30 30 30 60		Crane Operator Remote Operator Operator Operator Ragman Crane Operator Welder Crane Operator Welder Crane Operator	20 0 2 2 10 20 2 2 20 0 2 20 2 2 2 2 2 2	0 97 97 8.7 0.5 220 220 0.5 0.5 59 220 220 220 220 220 220 220	16.2 32.3 1.5 0.1 73.3 110.0 0.1 0.0 73.3 0.1 59.0 220.0 36.7 118.0	
h. Cult MESC (id i. Remove Arrulus Cutting Protection j. Remove MESC Outer (id k. Install Arrulus Cutting Protection L. Install Remote Cut Equipment m. Inner Ud Cut n. Remove Cutting Equipment o. Ril Annulus with Demineratized Water p. Install MESC Contamination Protection q. Connect Annulus Road Hoses	100 20 100 20 20 20 20 20 20 20 20 20 20 20 20 2	30 10 10 20 10 10 10 10 30 20 10 30 30 30 30 30 50 60 60 60 60 60 60 60 60 60 60 60 60 60		Crane Operator Remote Operator Operator Operator Ragman Crane Operator Operators Welder Crane Operator	20 0 2 2 10 20 2 2 20 0 2 20 2 2 20 2 2 2 2	0 97 97 8.7 0.5 220 220 0.5 59 220 59	16.2 32.3 1.5 0.1 73.3 110.0 0.1 0.0 73.3 0.1 59.0 220.0 36.7 118.0	
h. Cut MSSC (id i. Remove Arrulus Cutting Protection j. Remove MSSC Outer Lid k. Install Arrulus Cutting Protection t. Install Remote Cut Equipment m. Inner Lid Cut n. Remove Cutting Equipment o. Rill Arrulus with Demineralized Water p. Install MSSC Contamination Protection q. Connect Arrulus Roat Hoses f. Rill MSSC With Water	10000 10000 10000 10000 45	30 10 10 20 10 10 10 30 30 20 20 10 30 30 30 10 10 10 10 10 10 10 10 10 10 10 10 10		Crane Operator Remote Operator Operator Operator Operator Ragman Crane Operator Operators Welder Crane Operator Operators Welder Operators Welder Operators Operators	20 0 2 10 20 2 2 20 0 2 2 20 2 2 2 2 2 2	0 97 97 8.7 0.5 220 0.5 0.5 59 220 59 0	16.2 32.3 1.5 0.1 73.3 110.0 0.1 0.0 59.0 220.0 30.7 118.0 0.0	
h. Cut MSSC (id i. Remove Arrulus Cutting Protection j. Remove MSSC Outer Lid k. Install Arrulus Cutting Protection t. Install Remote Cut Equipment m. Inner Lid Cut n. Remove Cutting Equipment o. Rill Arrulus with Demineralized Water p. Install MSSC Contamination Protection q. Connect Arrulus Roat Hoses f. Rill MSSC With Water	10000 10000 10000 10000 45	300 100 100 200 100 100 100 200 200 300 300 300 300 300 300 300 3		Crane Operator Remote Operator Operator Operator Ragman Crane Operator Operators Welder Crane Operator	20 0 2 2 10 20 2 2 20 0 2 20 2 2 20 2 2 2 2	0 97 97 8.7 0.5 220 0.5 0.5 59 220 220 0.5 59 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	16.2 32.3 1.5 0.1 73.3 110.0 0.0 73.3 0.1 59.0 220.0 36.7 118.0 0.0	

Table A1-1. Utilities-Reference (continued)

							- 6 61	_
		25		Crone Operator	20	0.5	0.01	
LL Move Cask to Fuel Loading Pool Roar	30	30		Operators	20		0.0	Ť
		30		Crane Operator	30		0.0	-
v. Disengage Yoke From Cask	20	20		Operator	30	- 6	0.0	i
		20		Ragman		ő	0.0	-i
		20		Crane Operator	40	_		┪
w. Remove Yoke From Pool	10	10		Operators	10	0	0.0	
		10		Acomon	10	0	0.0	_
		10	1	Crane Operator	20	0	0.0	_(
7.4.4	2650	995			1		1123.3	4
Total								
A CONTRACTOR OF THE CONTRACTOR				assume shielded to 0.5 r	Trem.	7		
. Unload SNF from MESC/Transfer	10	10		Operators	20	0.5	0.2	
a. SNF Grappie Attached to Crane		- 'Y		0,000			0.0	_
b. Engage One SNF Assembly, (12 min. per case	1000	250		Operators	20	0.5	42	_
b1. Time for coak	250				20	0.5	1.2	-
c. Load SNF into cask	70	70	- 2	Operators	إصع		3.3	_
la	330	330						
					لمبيا			
Prep Unloaded MESC/Transfer from pool				asume pool backgrou	<u> 19 00</u>	60 3 M	eu/u	
a. Attach MESC Shield Plug Lit Roure to Crane	5	5	2	Operators	2	0	0.0	
A AROCH MESC & MEST TO SELECT	$\neg \neg$	5	1	Rooman	10	0	0.0	
		5		Crane Operator	20	٥	0.0	
in a company of the last Physics	20	20		Remote	0	0	0.0	\Box
b. Install MESC Shield Plug	-	5		Operator	30	0	0.0	
c. Engage Yoke to Calk	_ =	5		Roomen	30	0	0.0	$\overline{}$
				Crorie Operator	40	0	0.0	-
		5			10	0	0.0	
d. Lift MESC/Cask to Pool Surface	5	5	2	Operators	20	- 6	0.0	_
		5		Crane Operator			1.8	_
e. Install Shield Plug Retainers	10	10		Operator	2	11		
f. Lift MESC/Cosk into Prep/Decon Area	30	25		Operators	10	0.5	0.4	
(use decon building backgd dose)		30	1	Crane Operator	20	0.5	0.3	
p. Disengage Yoke from Cask	5	5	- 1	Coerator	2	11	0.9	
g. Deengage vake sall cas.		5	1	Ragman	10	0.5	0.0	
		5		Crane Operator	20	0.5	0.0	
		70		Operator	2	11	1.8	- (
h. Remove Shield Plug Retainen	10				10	0.5	0.8	
L Decon MESC/Cask and Yoke	120	90		Operator	20	0.5	0.3	
		40		Crane Operator			1.8	_
j. Hook Up Drain Equipment	10	10		Operator	_2		0.2	_
k. Partially Drain MESC and Armulus	20	20		Operator	10	0.5		
L Remove Annuals Sect	10	10		Operators	2	11	3.7	
m. Check MESC/Cask for Conformation	30	10	2	Radiation Protection	2		3.7	
	350	10	ī	Operator	2		1.8	
s Drain, Dry	20	10		Operator	2		1.8	
bb. Place Cask Lid		10		Ragman	10	0.5	0.1	
	 	10		Crane Operator	20	0.5	0.1	
	30	30		Operators	2		11.0	
cc. Decon Cark	30			Crane Operator	20			_
		30	_		2		7.3	
cld. Perform HP Survey	45	20		Radiation Protection				_
ee. Secure Cask Balted Lid	30	30	2	Operators	2	<u>' ''</u>		<u>ب</u>
Total	755	440	L	<u> </u>	<u> </u>	<u></u>	49.2	_*
					<u>: </u>	L		-
8. Prep Unloaded MESC/Transfer-	. –		Ι	caume no backgroun	d does	<u> </u>		_
6. Prep Unicode manay Indiana.	! 		T		<u>. </u>	:		L
					. 0	0		
Overpack for ISFSI	5	_	1	Operator		0	0.0	
Open Stoping Area Door				Prime Mover Operator				
Open Stoping Area Door	5 10	10	1	Prime Mover Operator		_	0.0	
Open Staging Area Door Move On-Site PM and Transporter to Staging Area	10	10	-	Prime Mover Operator Transporter Operator	15 15	C		
Open Staging Area Door Move On-Ste PM and Transporter to Staging Area Unintial On-Ste PM	10	10 10		Prime Mover Operator Transporter Operator Prime Mover Operator	15 15 15	. 0	0.0	_
Open Staging Area Door Move On-Ste PM and Transporter to Staging Area Unintial On-Ste PM	10	10 10 5		Prime Mover Operator Transporter Operator Prime Mover Operator Operator	15 15 15 2	0	0.0 1.8	
Open Staging Area Door Move On-Ste PM and Transporter to Staging Area Unintial On-Ste PM	10	10 10 5 10		Prime Mover Operator Transporter Operator Prime Mover Operator Operator Ragman	15 15 15 2 10	0 11 8.7	0.0 1.8 1.5	
Open Stoging Area Door Move On-Site PM and Transporter to Stoging Area Unitritian On-Site PM Engage Yoke to MESC/Cask	10	10 10 5 10		Prime Mover Operator Tiransporter Operator Prime Mover Operator Operator Ragman Crane Operator	15 15 15 2 10 20	0 11 8.7 0.5	0.0 1.8 1.5 0.1	
Cipen Stoging Area Door Move Ch-Site PM and Transporter to Stoging Area Unintial Ch-Site PM Engage Yoles to MESC/Calk Id. Close Stoging Area Door, simultaneously	5 10	10 10 5 10 10		Prime Mover Operator Transporter Operator Prime Mover Operator Operator Regman Crans Operator Operator	15 15 15 2 10 20 0	0.5	0.0 1.8 1.5 0.1	
Cipen Stoging Area Door Move Ch-Site PM and Transporter to Stoging Area Unintial Ch-Site PM Engage Yoles to MESC/Calk Id. Close Stoging Area Door, simultaneously	10	10 10 5 10 10		Prime Mover Operator Transporter Operator Prime Mover Operator Operator Ragman Octane Operator Operator	15 15 15 10 20 20	0.5 0.5 0.5	0.0 1.8 1.5 0.1 0.0	
Cipen Stoging Area Door Move Ch-Site PM and Transporter to Stoging Area Unintial Ch-Site PM Engage Yoles to MESC/Calk Id. Close Stoging Area Door, simultaneously	5 10	10 10 5 10 10		Prime Mover Operator Transporter Operator Prime Mover Operator Operator Ragman Crane Operator Operator Operator Operator	15 15 15 10 20 0 10 20	0.5 0.5 0.5 0.5	0.0 1.8 1.5 0.1 0.0 13.1	
Copen Staging Area Door Move On-Site PM and Transporter to Staging Area Unintoh On-Site PM Is Engage Yoke to MESC/Cask d1. Close Staging Area Door, simultaneously Place MESC/Cask on Transporter	5 10	10 10 5 10 10 10		Prime Mover Operator Transporter Operator Prime Mover Operator Operator Ragman Crane Operator Operator Operator Coperator Coperator Coperator Coperator Radiation Profection	15 15 15 2 10 20 0 10 20 20	0.5 0.5 0.5 0.5 0.5	0.0 1.8 1.5 0.1 0.0 13.1 0.4	
Copen Staging Area Door Move On-Site PM and Transporter to Staging Area Uninted On-Site PM It Engage Yoke to MESC/Cask d1. Close Staging Area Door, simultaneously Paces MESC/Cask on Transporter Perform Release HP Survey	10	10 10 5 10 10 10 45 45		Prime Mover Operator Transporter Operator Prime Mover Operator Operator Ragman Crane Operator Operator Operator Operator	15 15 15 20 10 20 0 10 20 20 20	0.5 0.5 0.5 0.5 0.5	0.0 1.8 1.5 0.1 0.0 13.1 0.4 11.0 22.0	
Copen Stoging Area Door Move On-Site PM and Transporter to Stoging Area Uninitian On-Site PM It Engage Yoke to MESC/Cark It. Close Staging Area Door, simultaneously Prace MESC/Cask on Transporter Perform Release HP Survey Install Cask Restraints	10 5 10 45 60	10 10 5 10 10 10 0 45 45		Prime Mover Operator Transporter Operator Prime Mover Operator Operator Ragman Crans Operator Operator Operator Coperator Coperator Radiation Protection Operator	15 15 15 2 10 20 0 10 20 20	0.5 0.5 0.5 0.5 0.5	0.0 1.8 1.5 0.1 0.0 13.1 0.4 11.0 22.0	
Copen Stoging Area Door Move On-Site PM and Transporter to Stoging Area Unintich On-Site PM Engage Yoles to MESC/Calk It is page Yoles to MESC/Calk It is page Yoles to MESC/Calk Place MESC/Calk on Transporter Perform Release HP Survey Instal Calk Restroints To Open Prep Area Door	10 5 10 45 60 60	10 10 5 10 10 10 0 45 45 30		Prime Mover Operator Transporter Operator Prime Mover Operator Operator Operator Crans Operator Operator Operator Coperator Prime Mover Operator Practical Operator Registration Profesion Profesion Operator Operator	15 15 15 20 10 20 0 10 20 20 20	0.5 0.5 0.5 0.5 0.5 11	0.0 1.8 1.5 0.1 0.0 13.1 0.4 11.0 22.0	
Copen Stoging Area Door Move On-Site PM and Transporter to Stoging Area Unintoh On-Site PM It Engage Yoke to MESC/Cask It Engage Yoke to MESC/Cask It Reporter Transporter Perform Release HP Survey Install Cask Restraints Open Prep Area Door Percore Transfer Papers	10 5 10 10 45 60 60 5	10 10 10 10 10 10 45 45 30		Prime Mover Operator Transporter Operator Prime Mover Operator Operator Regman Crane Operator Operator Operator Coperator Coperator Coperator Coperator Coperator Reaction Protection Operator	15 15 15 10 20 0 10 20 20 20 0 0	0.5 0.5 0.5 0.5 11 0.5	0.0 1.8 1.5 0.1 0.0 13.1 0.4 11.0 22.0 0.0	
Copen Stoging Area Door Move Ch-Site PM and Transporter to Stoging Area Unintich Ch-Site PM It Engage Yoke to MESC/Cask It Engage Yoke to MESC/Cask It Place Staging Area Door, simultaneously Place MESC/Cask on Transporter Perform Release HP Survey Install Cask Restraints Copen Prep Area Door Prep Area Door Prep Promiser Papers It Move MESC/Cask Outside Protected Area	10 5 10 10 45 60 60 5 10	100 100 100 100 100 455 455 455 600 100 100 100 100 100 100 100 100 100		Prime Mover Operator Transporter Operator Prime Mover Operator Operator Ragman Octane Operator	15 15 15 10 20 20 10 20 20 20 0 10 10 10 10 10 10 10 10 10 10 10 10	0.5 0.5 0.5 0.5 0.5 11 11 0.5 0.5 0.5	0.0 1.8 1.5 0.1 0.0 13.1 0.4 11.0 22.0 0.0 0.0	
Copen Stoging Area Door Move Ch-Site PM and Transporter to Stoging Area Unintich Ch-Site PM It Engage Yoke to MESC/Cask It Engage Yoke to MESC/Cask It Place Staging Area Door, simultaneously Place MESC/Cask on Transporter Perform Release HP Survey Install Cask Restraints Copen Prep Area Door Prep Area Door Prep Promiser Papers It Move MESC/Cask Outside Protected Area	10 5 10 10 45 60 60 5	10 10 10 10 10 10 45 45 30 60 60 60		Prime Mover Operator Transporter Operator Prime Mover Operator Operator Ragman Crane Operator Operator Operator Coperator Operator Operator Operator Radiation Protection Operator Operator Operator Operator	15 15 15 10 20 10 20 20 20 20 10 10 10 10 10 10 10 10 10 10 10 10 10	0.5 0.5 0.5 0.5 0.5 11 11 0.5 0.5	0.0 1.8 1.5 0.1 0.0 13.1 11.0 22.0 0.0 0.0 0.0 0.1	
2. Open Stoging Area Door 2. Move On-Site PM and Transporter to Stoging Area 2. Unhitch On-Site PM d. Engage Yoke to MESC/Cask d1. Close Stoging Area Door, simultaneously e. Place MESC/Cask on Transporter Perform Release HP Survey g. Install Cask Restraints h. Open Prep Area Door L. Prepare Transfer Papers L. Move MESC/Cask Outside Protected Area	10 5 10 10 45 60 60 5 10	10 10 10 10 10 45 45 30 60 60 60 10 30		Prime Mover Operator Transporter Operator Prime Mover Operator Operator Ragman Crans Operator Operator Coperator Coperator Radiation Protection Operator Operator I Operator Operator Operator Operator	15 15 15 10 20 10 20 20 20 20 10 10 15 15 15	0.5 8.7 0.5 8.7 11 11 0.5 0.5 0.5 0.5	0.0 1.8 1.5 0.1 13.1 0.4 11.0 22.0 0.0 0.0 0.0 1.3 1.3 11.0 0.4 12.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
a. Open Stoging Area Door b. Move Ch-Site PM and Transporter to Stoging Area c. Unhitch Ch-Site PM d. Engage Yote to MESC/Cask d1. Close Stoging Area Door, simultaneously e. Place MESC/Cask on Transporter f. Perform Release HP Survey g. Install Cask Restraints h. Open Prep Area Door L. Prepare Transfer Papers L. Move MESC/Cask Outside Protected Area	10 5 10 10 45 60 60 5 10	100 100 100 100 100 100 100 100 100 100		Prime Mover Operator Transporter Operator Prime Mover Operator Operator Operator Crans Operator Operator Crans Operator Rediction Protection Operator Operator Operator Operator Operator Operator Operator Operator Operator	15 15 15 10 20 10 20 20 20 20 10 10 15 15 15 15 20 20 20 20 20 20 20 20 20 20 20 20 20	0.5 8.7 0.5 8.7 0.5 11 11 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.0 1.8 1.5 0.1 0.0 13.1 11.0 20.0 0.0 0.0 0.1 8.7 0.3	
a. Open Staging Area Door b. Move Ch-Site PM and Transporter to Staging Area c. Unhitch Ch-Site PM d. Engage Yotes to MESC/Cask d1. Close Staging Area Door, simultaneously e. Place MESC/Cask on Transporter f. Perform Release HP Survey g. Install Cask Restraints h. Open Prep Area Door	10 5 10 10 45 60 60 5 10	10 10 10 10 10 45 45 30 60 60 60 10 30		Prime Mover Operator Transporter Operator Prime Mover Operator Operator Ragman Crans Operator Operator Coperator Coperator Radiation Protection Operator Operator I Operator Operator Operator Operator	15 15 15 10 20 10 20 20 20 20 10 10 15 15 15	0.5 8.7 0.5 8.7 0.5 11 11 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.0 1.8 1.5 0.1 0.0 13.1 11.0 20.0 0.0 0.0 0.1 8.7 0.3	

Table A1-2. Utilities-TSC

otal Doses per Cask for ISC at the Utilities	7			Rail mrem/hr		Bookgrou	.nd	
evised 20 May 94/HWG				Lid does		UROUV)A		
	Drect	Bkgd	3.6		_	area :		
ood TSC for Rail Shipment	Denon			outer		crone	0.25	
Sept-(1.2.3.4.5)	717	142	859	Tp/ix contid		decon		
				Lateral Skin	- 37	632		
ood TSC for Storage	782	152	- 624	Storage cask mrem/tv		13-3	9	
Steps (1.2.3.4.6)	- /°2	132	732	imer	220	ra.d		
				outer	97			
iot TSC from Storage for Rail Shipment	492	37	530	Tp/fx cosk lid	70			
Stepte(7)			330	Lateral Sidn	70			
								F
	iotal Task Time(Mix.)	Dose Wne(Mn.)	Personnel Recutred (Persons/Tosk)	Occupation	Worlding Distance (Feet)	Cast Dose Rotetinismifm)	Dose Received (Perion-mem)	(mexit close backacing (mexit closes)
Cask Handling Operations								
. Receive Unloaded TNC				assume arane area ba				
a. Inspect Bills of Locking, Other Shipping Papers	10	10		Operator	<u> </u>		0.0	0.0
b. Release Off-Site Prime Mover (PM)	10	10		Prime Mover Operator	15		0.0	0.0
c. Hitch On-Site Prime Mover	10	10		Prime Mover Operator			0.0	Q.C
d. Perform Receipt HP Survey	40	40		Radiation Protection	2		0.0	0.0
a. Move Cask to Protected Area Gate	20	20		Prime Mover Operator			0.0	0.0
f. Security impection	30	30		Security Officers	2		0.0	0.0
g. Open Prep Area Door	5	5		Operator			0.0	0.0
h. Maus Cosk to Prep Ared	30	30		Prime Mover Operator			0.0	0.0
t. Remove Personnel Barrier/Impact Limiters	90	90		Operators	2		0.0	0.6
		90		Crone Operator	2			_
j. Close Prep Ared Door	5			Operator	- 2			
k. Remove Cosk Restraints	- 60			Operators				
L. Perform Preliminary HP Survey	40	40		Radiction Protection		0		
m. Engage Yoke to Cask	 3			Operators Rogman	1 10			
				Crane Operator	20			
	30	دينتيسا فسيدؤ		Operators	10		0.0	0.
n. Ult Cosk into Prepi Area		30	_	Crane Operator	20		0.0	0.
	385		_			1	مە	2.
Total - Receive Unloaded ISC	_		1					
a now the factor of the land		†	1	Carrune book case:				
2. Prep ISC for loading in Pool a. Install Shield Platform	30	30		Operator		0	0.0	
b. Attach Gas Sampling/Vent Equipment	5	1	5	Operator		2 0		
c. Sample Gas Cavity	30			Operator		2 0	0.0	
11.00	30	3(]	Operator		2 0	0.0	_
Very Cast Covity Install Cast tid Litting Device	2			2 Operators		2 0		
		21		Rogman	10			
				Crane Operator	2			
f. Loosen/Remove Cask Outer Ud				2 Operators		0 0		_
		6		1 Rogman	2			
		- 4		1 Crone Operator		2 0		
g. RE Cask with Water	_ -			2 Operators 1 Operator		2 0		
h. Remove Sampling/Venting Equipment	1 2			2 Operators		2 0		
i. Loosen Cosk Inner Lid Bolts	10			1 Operator		2 0		
j. Afforch Lid Sing to Cosk Yoke				1 Rogman		0 0	0.0	0
				1 Crone Operator	2	0 0	0.0	0 (
k. Install Conformingtion Protection on Cask			_	2 Operators		2 0		
L Remove Sheld Plufform	3			1 Operator		6 0		
m. Lift Cosk onto Paol Pictform	2			2 Operators		0 0		
				1 Crane Operator		0 0		
n. Remove Remaining Lid Bolts	3			2 Operators		2 0		
c. Lift Cask to Pool Bottom	3			2 Operators		0 0		
				1 Crane Operator				
	1	_	9	1 Operator				
p. Disengage Yoke		1 1	0	1 Rogman		0 0		_
p. Disengage Voice					1 4			
			0	1 Crane Operator		0 0		
p. Disengage Yoke a. Remove Yoke and Cask Lid from Pool	2	0 2				2 0	0.0	0 1

Table A1-2. Utilities-TSC (continued)

	440	595				l	0.0 \$4
otal - Prep TSC for loading in Pool							
Load SHF into Rall Transportation Cank				Dero loog emusso			
SME Grande Attached to Citing	10	10	2	Operators	20	0.5.	0.2
Engage One SNF Assembly, (12 min. per assembly)						0.5	42 2
b1. Time for cosk	250	250		Operators	20 20		12
Load SNF Into Cark	330	70 330		Operators			5.5 3
olal - Load SNF Into Ball Transportation Cark	330	330				 	
						i	
Prep ISC from Pool (scale up from truck for area or diameters	:	2)	casume pool area			
a. Impect Cask Seal (scalameter)	20	20		Operator	2	0	0.0
b. Place Cask Inner Lid and Engage Yake	25	25	2	Operators	30		0.0
		25		Ragman	30		0.0
		25		Crane Operator			0.0
c. Ult Cark to Pool Surface	10	10		Operators	10 20		0.0
		10		Crane Operator Operator	<u></u> 2		811
d. Install Two Cask Lid Botts	5 20	20		Operators	10		1.2
e. Ult Calk into Prep/Decon Area	- 2	20		Crane Operator	20		0.2
Decontaminate Yake and Caricadameter)	80	80	_	Operator	10		11.6
1. Decoramenda Take a so Curaciana		80		Crane Operator	20	0.5	0.7
g. Disengage Yoke and Lid Sing from Cask	10	10	1	Operator	2		28 (
A see different and an	,	10		Rogman	10		1.5
		3		Crane Operator	20		0.1
h. Attach Vent and Drain Lines	5	5		Operator	2		8.1
i. Drain Cosk(scilometer)	110	35		Operator Radiation Protection	2		50.2
J. HPS.rvey(xdumeter)	80 55	35 55		Operators	2		177.8
k. Secure inner Coak Bolled Ud(xcdcmeter)	1 10	39		Operators	30		0.0
L Place Cark Outer tild and Engage Yoke	 "	10		Ragman	30		0.0
	1	10		Crane Operator	40	0.	00 (
m. Secure outer Cosk Bolfed Ud	55	55		Operators	2	60	110.0
n. Connect Drying and inerting Equipment	10	10	1	Operator	2		10.0
o. Drain, Dry, and Inert Casidsdameter)	160	160	_	Operator	2		45.3
		160		Operator	10		23.2
p Remove Drain, Drying, and inerling Equipment	10	10		Operator	2		10.0 C
q. Perform Leak Test on Seal(s:clameter)	20		<u> </u>	Operator	2		4763 50
lotal - Prep ISC from Pool	685	925				 	4/42
and the second of the second	•					<u> </u>	
5. Prep TSC from Pool Prep area for Shipping (scale up from truck for area or diame	}	1.80	3004	perpheryes	1.2	CERUMN FLA	backgro
	1 5			Operator	0		0.0
b. Move On-Site PM and Transporter to Prep Area	10	10		Prime Mover Operator	15		0.1
c. Uthlich On-Ste PM	5			Prime Mover Operator	15		0.0
d. Engage Yake to Cask	10			Operator	2		2.8
	ļ	10		Rogman Crane Operator	10		0.1
		10			- 20		
d1. Close Pool Prep Area Door, struttansously with Stat	, <u> </u>				20		
Place Cask on Transporter	46	0	1	Operator	9	0	0.0
	45	45	1 2	Operator Operators		1.8	
		45	1 2	Operator	3 10	0 1.8 0.5	0.0 (2.7 (
f. Perform Release HP Survey (stated -diameter)	80 35	45 45 35	1 2	Operators Crane Operator	9 10 20	0 1.8 0.5 43 32	0.0 (0 2.7 (0 0.4 (0 50.2 (0 37.3 (0
Perform Release HP Survey (scarca -diameter) Install Cask Restraints(speriphery)	80	45 45 35	2	Operators Operators Orane Operator Raciation Protection	9 10 20 2	0 1.8 0.5 43 32	0.0 (2.7 (0.4 (50.2 (
f. Perform Relicate HP Survey (screen-diameter) p. Install Cook Restroints(speciphery)	80	45 35 35 35 35	1 2 2 2 1 1 2	Operator Operators Orans Operator Raciotion Protection Operators Operators Operators	9 10 20 2 2 2 20 20	0 1.8 0.5 43 32 0.5 2	0.0 (2.7 (4.6) 0.4 (4.6) 50.2 (4.6) 37.3 (4.6) 0.3 (4.6) 58.7 (4.6)
f. Perform Relecte HP Survey (scared -diameter)	80 35 55	45 45 35 35 35 55	1 2 2 2 1 1 2 2 1 1 1 1 1 1 1 1 1 1 1 1	Operator Operators Crans Operator Raciolion Protection Operators ICrans Operator Operators ICrans Operator	9 10 20 2 2 20 20 2	0 1.8 0.5 43 32 0.5 32	0.0 (2.7 (4.50.2 (5.0.2
f. Perform Release HP Survey (screar-diameter) p. Install Cask Restroints(speriphery)	35	45 45 35 35 35 55 55	1 2 2 2 2 1 1 2 2 2 1 1 2 2 2 1 1 2	Operator Operators Crone Operator Resistion Protection Operators ICrone Operator ICperators ICrone Operator ICperators ICrone Operator	9 10 20 2 2 20 20 20	0 1.8 0.5 43 32 0.5 32 0.5 32	0.0 (2.7 (0.4 (0.5 (0.5 (0.5 (0.5 (0.5 (0.5 (0.5 (0.5
Perform Release HP Survey (stated-diameter) Install Casic Restraints(speriphery) Install Impact Limiters(stated-diameter) Install Personnel Barrier(speriphery)	80 35 55	45 46 35 35 35 55 55 70	1 2 1 2 2 1 2 1 2 2	Operator Operators Orans Operator Raciation Protection Operators Icrans Operator Operators Icrans Operator Icrans Operator Icrans Operator	9 10 20 2 2 20 20 2 20	0 1.8 0.5 43 32 0.5 32 0.5 32 0.5	0.0 2.7 0.4 50.2 0.3 0.3 0.5 58.7 0.5 74.7 0.3
1. Perform Release HP Survey (scared -diameter) 2. Install Casic Restraints/(speriphery) 3. Install Impact Limiten(scared -diameter) 4. Install Personnel Barrier(speriphery) 5. Prepare Shipping Papers	80 36 56 70	45 36 35 35 55 56 70	1 2 2 2 1 1 2 2 1 1 2 2 1 1 1 1 1 1 1 1	Operator Operators Orans Operator Raciological Protection Operators	9 10 20 2 2 20 20 20 20 20 0	0 1.8 0.5 43 32 0.5 32 0.5 32 0.5 0.5	0.0 (2.7 (0.4 (0.50.2 (0.5 (0.5 (0.5 (0.5 (0.5 (0.5 (0.5 (0.5
Perform Release HP Survey (scarea -diameter) Install Cook Restrainth(speriphery) Install Impact Limiten(scarea -diameter) Install Personnel Barrier(speriphery) Prepare Shipping Papers Cook Prep Area Door	80 35 55 70	45 35 35 35 56 56 70 0	2 2 2 2 2 1 2 2 1 2 2	Operator Operator Operator Operator Resident Protection Operators Operator	9 10 20 2 2 20 20 2 20	0 1.8 0.5 43 32 0.5 32 0.5 32 0.5 0.5 0.5	0.0 2.7 0.4 50.2 0.3 0.3 0.5 74.7 0.3 0.0 0.0
E. Perform Release HP Survey (screal-diameter) E. Install Calic Restrainth(speriphery) Install Impact Limiten(scared-diameter) Install Personnel Barrier(speriphery) J. Prepare Shipping Papels I. Open Prep Area Door I. Hisch Ch-Site Prime Mover	80 36 56 70	45 35 35 35 56 70 35 0	22 11 22 23 11 22 11 22 11 11	Operator Operators Orans Operator Raciological Protection Operators	9 10 20 2 2 20 20 20 20 20 0 0	0 1.8 0.5 43 32 0.5 32 0.5 32 0.5 0.5 0.5	0.0 0.4 0.4 0.5 0.3 0.5 0.5 0.5 0.0 0.0 0.0 0.0 0.3
f. Perform Release HP Survey (scared -diameter) p. Install Craix Restrainth(speriphery) h. Install impact Limiten(scared -diameter) t. Install Personnel Barrier(speriphery) t. Prepare Shipping Papers t. Open Prep Area Door t. Hitch Ch-Site Prime Mover m. Move Craix to Protected Area Gate	80 35 55 70 10 5	45 35 35 56 56 70 35 56 56 56 35 35 35 56 56 35 35 56 56 56 56 56 56 56 56 56 56 56 56 56	2 2 2 2 2 1 2 2 1 1 1 1	Operator Operators Orans Operator Resident Protection Operators Operators Operators Operators Operators Operators Operators Operator Operator Operator Operator	9 10 20 2 2 20 20 20 20 0 0 0 15 15	0 1.8 0.5 43 32 0.5 32 0.5 0.5 0.5 0.5 0.5 0.5	0.0 2.7 0.4 50.2 37.3 0.3 58.7 0.5 74.7 0.3 0.0 0.0 0.0
f. Perform Release HP Survey (scared -diameter) p. Install Craix Restrainth(speriphery) h. Install Impact Limiters(scared -diameter) p. Install Impact Limiters(scared -diameter) p. Install Personnel Borrier(speriphery) p. Prepare Shipping Papers p. Open Prep Alexander p. Hitch Ch-Ste Prime Mover p. Move Craix to Profested Area Gale p. Perform Security check	\$0 35 55 70 10 5 5 30	45 45 35 35 55 55 70 36 0 0 35 35 35 55 55 55 55 55 55 55 55 55 55		Operator Operator Operator Operator Raciotion Protection Operators Operators Operators Operators Operators Operators Operators Operators Operator	9 10 20 2 2 20 20 20 0 0 15 15 2 15	0 1.8 0.5 32 0.5 32 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.0 2.7 0.4 50.2 37.3 0.3 0.5 74.7 0.3 0.0 0.0 0.0 0.0 0.3 2.8
f. Perform Release HP Survey (scarce -diameter) p. Install Cask Restraints(speriphery) p. Install Impact Limiter(scarce -diameter) p. Install Personnel Barrier(speriphery) p. Prepare Shipping Papers p. Open Prep Area Door p. Hitch On-Site Prime Mover p. Move Cask to Protected Area Gate p. Perform Security check p. Untitled On-Site Prime Mover	\$0 35 55 70 10 5 5 5 5 5 5 60	46 46 36 35 35 55 55 70 36 0 0 0 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		Operator Operator Operator Operator Operator Operators Operators Operators Operators Operators Operators Operators Operators Operators Operator	90 100 200 22 200 200 200 00 155 155 155	0 1.8 0.5 43 32 0.5 32 0.5 32 0.5 0.5 0.5 0.5 0.5 0.5 17 0.5	0.0 2.7 0.4 50.2 37.3 0.3 58.7 0.5 74.7 0.3 0.0 0.0 0.0 0.0 0.3 2.8 0.0
E. Perform Release HP Survey (screen -diameter) Install Cosic Restraints(speriphery) Install Impact Limiters(screen -diameter) Install Personnel Barrier(speriphery) Prepare Shipping Papets Copen Prep Area Door Hoth Ch-Site Prime Mover Move Casic to Protected Area Gate Perform Security check Unhitch Ch-Site Prime Mover Mide-up with other casic cars per froin High Off-Site Prime Mover	55 55 70 10 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	46 46 36 35 35 55 55 70 36 0 0 0 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		Operator Operator Operator Operator Raciotion Protection Operators Operators Operators Operators Operators Operators Operators Operators Operator	9 10 20 2 2 20 20 20 0 0 15 15 2 15	0 1.8 0.5 43 32 0.5 32 0.5 0.5 0.5 0.5 0.5 17 0.5 17 0.5	0.0 2.7 0.4 50.2 37.3 0.3 58.7 0.5 74.7 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0
E. Perform Release HP Survey (screen -diameter) Install Cosic Restraints(speriphery) Install Impact Limiters(screen -diameter) Install Personnel Barrier(speriphery) Prepare Shipping Papets Copen Prep Area Door Hoth Ch-Site Prime Mover Move Casic to Protected Area Gate Perform Security check Unhitch Ch-Site Prime Mover Mide-up with other casic cars per froin High Off-Site Prime Mover	\$0 35 55 70 10 5 5 5 5 5 5 60	46 46 36 35 35 55 55 70 36 0 0 0 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		Operator Operator Operator Operator Operator Operators Operators Operators Operators Operators Operators Operators Operators Operators Operator	90 100 200 22 200 200 200 00 155 155 155	0 1.8 0.5 43 32 0.5 32 0.5 0.5 0.5 0.5 0.5 17 0.5 17 0.5	0.0 2.7 0.4 50.2 37.3 0.3 58.7 0.5 74.7 0.3 0.0 0.0 0.0 0.0 0.3 2.8 0.0
E. Perform Release HP Survey (screen -diameter) Entatel Cosk Restraints(speriphery) Entatel Impact Limiter(screen -diameter) Entatel Personnel Barrier(speriphery) Prepare Shipping Papers E. Open Prep Area Door Hitch Co-Site Prime Mover Move Cosk to Profected Area Gate Perform Security check D. Uninter Co-Site Prime Mover D. Male-up with other cask cars per train G. Hitch Off-Site Prime Mover D. Male-up with other cask cars per train G. Hitch Off-Site Prime Mover D. Male-up With other cask cars per train G. Hitch Off-Site Prime Mover Lotal - Prep TSC from Pool Prep area for Shipping	\$0 36 55 10 10 5 5 5 5 5 60 40	45 45 35 35 55 70 36 0 0 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		Operator Operators Orans Operator Raciation Protection Operators Ocerators Ocerators Operators Operators Operators Operators Operators Operators Operators Operator	9 10 20 2 2 2 20 20 0 0 0 15 15 15 15 15	0 1.8 0.5 32 0.5 32 0.5 0.5 0.5 0.5 0.5 0.5 17 0.5 1.2	0.0 2.7 0.4 50.2 37.3 0.3 58.7 0.5 74.7 0.3 0.0 0.0 0.0 0.0 2.8 0.0 2.4 0.0 236.1
E. Perform Release HP Survey (scarce -diameter) Ential Cask Redraints(speriphery) Ential Impact Limiters(scarce -diameter) Ential Personnel Barrier(speriphery) Prepare Shipping Papers C. Open Prep Area Door Hitch Consite Prime Mover Move Cask to Protected Area Gate Perform Security check D. Unforth Consite Prime Mover Male-up with other cask cars per train Hitch Off-Site Prime Mover Hitch Coff-Site Prime Mover Male-up with other cask cars per train Hitch Off-Site Prime Mover Hotal - Prep TSC from Pool Prep area for Shipping Frep TSC for Storage(scale up from truck for area or di	\$0 36 55 10 5 5 5 5 5 5 5 5 5 5 40	45 45 35 35 55 55 55 70 0 0 0 5 5 5 5 5 5 5 5 5 5	2 2 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Operator Operators Orans Operator Raciotion Protection Operators Operators Operators Operators Operators Operators Operators Operators Operator Internet Operator Internet Mover Operator Prime Mover Operator Prime Mover Operator Internet Mover Operator Internet Mover Operator	90 100 200 20 20 20 20 00 00 155 155 155 155	0 1.8 0.5 4.3 32 0.5 0.5 0.5 0.5 1.7 0.5 1.2 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.0 2.7 0.4 50.2 37.3 0.3 58.7 0.5 74.7 0.3 0.0 0.0 0.0 0.0 2.8 0.0 2.4 0.0 2.5 1.1
E. Perform Release HP Survey (scarea -diameter) Install Cosk Redrainth(speriphery) Install Impact Limiter(scarea -diameter) Install Personnel Barrier(speriphery) Install Personnel Bar	\$0 35 55 10 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	45 45 35 35 55 55 70 0 0 0 5 5 5 5 5 5 5 5 5 5 5 5	1 2 2 1 1 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1	Operator Operators Orane Operator Raciotion Protection (Operators (Operator	90 20 20 22 20 20 20 00 00 155 155 15 15 15	0 1.8 0.5 43 32 0.5 32 0.5 0.5 0.5 0.5 0.5 1.2 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.0 2.7 0.4 50.2 37.3 0.3 58.7 0.5 74.7 0.3 0.0 0.0 0.0 0.0 2.8 0.0 2.4 0.0 2.5 1.1 0.0 2.5 1.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
E. Perform Release HP Survey (scarea -diameter) Install Cosk Redrainth(speriphery) Install Impact Limiter(scarea -diameter) Install Personnel Barrier(speriphery) Install Personnel Bar	\$0 36 55 10 5 5 5 5 5 5 5 5 5 5 40	45 45 35 35 55 55 70 0 0 0 5 5 5 5 5 5 5 5 5 5 5 5	1 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Operator Operators Operators Orans Operator Raciation Protection Operators Operators Operators Operators Operators Operators Operators Operator	90 100 200 20 20 20 20 00 00 155 155 155 155	0 1.8 0.5 43 32 0.5 32 0.5 0.5 0.5 0.5 0.5 1.7 0.5 1.2 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.0 2.7 0.4 50.2 37.3 0.3 58.7 0.5 74.7 0.3 0.0 0.0 0.0 0.0 2.4 0.0 2.4 0.0 2.4 0.0 2.5 1 does 0.7 0.0
E. Perform Release HP Survey (scarea -diameter) Install Cask Redrainth(speriphery) Install Impact Limiter(scarea -diameter) Install Personnel Barrier(speriphery) Install Personnel Bar	\$0 36 55 10 10 5 5 5 5 5 60 5 5 440	45 45 35 35 55 55 70 36 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	1 2 2 2 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3	Operator Operators Orane Operator Raciotion Protection (Operators (Operator	9 10 20 22 20 20 20 0 0 0 15 15 15 15	0 1.8 0.5 4.3 32 0.5 32 0.5 0.5 0.5 17 0.5 1.2 0.5 0.5 1.2 0.5 0.5 0.5 1.2 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.0 2.7 0.4 50.2 37.3 0.3 58.7 0.5 74.7 0.3 0.0 0.0 0.0 0.0 2.8 0.0 2.8 0.0 2.8 1 0.0 2 1 0.0 2 1 0.0 2 1 0.0 2 0 0.0 2 0 0 0 0 0 0 0 0 0 0 0 0 0
E. Perform Release HP Survey (scarce -diameter) Install Cask Restraints(speriphery) In Install Impact Limiter(scarce -diameter) Install Personnel Barrier(speriphery) Install Cask to Protected Area Gate Install Cask to Protected Are	\$0 35 55 10 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	45 45 35 35 55 55 55 55 55 55 55 5	1 2 2 1 1 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1	Operator Operators Orans Operator Raciation Protection Operators I Crans Operator I Operators I Crans Operator I Operators I Operators I Operators I Operators I Operator I Prime Mover Operator I Operator I Prime Mover Operator I Prime Mover Operator I Prime Mover Operator I Prime Mover Operator I Operator I Operator I Operator I Operator	9 10 20 20 20 20 20 20 20 20 20 20 20 20 20	0 1.8 0.5 4.3 32 0.5 0.5 0.5 0.5 1.2 0.5 1.2 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.0 2.7 0.4 50.2 37.3 0.3 58.7 0.5 74.7 0.3 0.0 0.0 0.0 0.0 2.8 0.0 2.4 0.0 2.5 1.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
f. Perform Release HP Survey (scared -diameter) p. Install Craix Restrainth(speriphery) h. Install Impact Limiters(scared -diameter) p. Install Impact Limiters(scared -diameter) p. Install Personnel Borrier(speriphery) p. Prepare Shipping Papers p. Open Prep Alexander p. Hitch Ch-Ste Prime Mover p. Move Craix to Profested Area Gale p. Perform Security check	\$0 36 55 10 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	45 45 35 35 55 55 70 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	1 2 2 1 2 2 1 1 2 2 1 1 1 1 1 1 1 1 1 1	Operator Operators Orans Operator Raciation Protection Operators Ocrans Operator Operators Operators Operators Operators Operator Operator Operator Operator Prime Mover Operator Prime Mover Operator	90 100 200 200 200 200 200 200 200 200 20	0 1.8 0.5 43 32 0.5 32 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.0 2.7 0.4 50.2 37.3 0.3 58.7 0.5 74.7 0.3 0.0 0.0 0.0 0.0 2.8 1.5 1.5
E. Perform Release HP Survey (scarce -diameter) Install Cask Restraints(speriphery) In Install Impact Limiter(scarce -diameter) Install Personnel Barrier(speriphery) Install Cask to Protected Area Gate Install Cask to Protected Are	\$0 36 55 10 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	45 45 35 35 55 55 70 38 30 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Operator Operators Orans Operator Raciation Protection Operators I Crans Operator I Prime Mover Operator I Transporter Operator I Prime Mover Operator I Operator I Prime Mover Operator I Operator I Operator I Operator	90 100 200 20 20 20 20 0 0 0 0 15 15 15 15 15 15 15 15 2 2 15 15 15 15 2 2 2 2	0 1.8 0.5 43 32 0.5 32 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.0 2.7 0.4 50.2 37.3 0.3 58.7 0.5 74.7 0.3 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
E. Perform Release HP Survey (screen -diameter) Entatel Cask Restraints(speriphery) Entatel Impact Limiters(screen -diameter) Entatel Personnel Barrier(speriphery) Prepare Shipping Papets Copen Prep Area Door Hitch Ch-Site Prime Mover Move Cask to Profesched Area Gate Perform Security check United On-Site Prime Mover Make-up with other cask cars per froin Hitch Off-Site Prime Mover Make-up with other cask cars per froin Hitch Off-Site Prime Mover Frep TSC form Pool Prep area for Shipping Frep TSC for Storage (scale up from truck for area or dia Open Stoping Area Door Move On-Site PM and Transporter to Stoping Area C. Untilich On-Site PM	\$0 36 55 10 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	45 45 35 35 55 55 55 55 55 55 55 5	1 2 2 1 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Operator Operator Operator Operator Operator Raciotion Protection Operators Operators Operators Operators Operators Operators Operator Operator Operator Operator Prime Mover Operator Operator Prime Mover Operator	90 100 200 200 200 200 000 155 155 150 150 151 151 1	0 1.8 0.5 1.2 0.5 1.2 0.5 1.2 0.5 1.2 0.5 1.2 0.5 1.2 0.5 1.2 0.5 1.2 0.5 1.2 0.5 1.2 0.5 1.2 0.5 1.2 0.5 1.2 0.5 1.2 0.5 1.2 1.2 0.5 1.2 1.2 1.2 1.2 1.2 1.2 1.2 1.2 1.2 1.2	0.0 2.7 0.4 50.2 37.3 0.3 58.7 0.5 74.7 0.3 0.0 0.0 0.0 0.0 2.8 1.5 1.5

Table A1-2. Utilities-TSC (continued)

				S-deltas Protection	2	50	108.2	0.0
Perform Release HP 9 :rvey (s: cliameter)	110	<u>56</u>		Radiation Protection Operators	2	32	74.7	0.0
install Cosk Restraints (s: periphery)	5			Operator	0	0	0.0	0.0
Open Prep Area Door	10	하		Operator	0	0	0.0	QC
Penore Transfer Papilis	10	-10		Prime Mover Operator	15	. 0.5	0.1	0.0
Move TSC Outside Protected Area	- 60	30		Operators	10	8.7	8.7	0.0
Move TSC to Storage	 	30		Prime Mover Operator	15	0.5	0.3	0.0
	 -	30		Crane Operator	20	0.5	0.3	0.0
	 	30	1	Radiation Protection	10	8.7	44	0.0
	20	10		Operators	2	50	19.7	0.7
Ursecure Cosk from Transporter	1	20	1	Frameporter Operator	15	0.5	0.2	0.7
e ER background dose)	1	10	1	Radiation Protection	10	8.7	1.5	0.
- Pod	- 60	30	2	Operators	2	50	59.0	2
Place Storage Cast on Pad	1	60		Transporter Operator	15	0.5	0.5	1.
	1	30	1	Radiation Protection	10	8.7	44	-1.
	50	25		Operators	10	0.5	0.4	-
Return Transport to Transfer Facility	1	25	1	Transporter Operator	15	0.5	0.2	_
	1	25	1	Radiation Protection	10	0.5	0.2	10.
	470	(136				<u></u>	300.2	10.
tal - Prep TSC for Storage	1							_
Peop ISC from ISPSI for shipping (scale up from truck to	((200 Of C	lain-					 +	_
Prep ISC from Isrst til sampsangerses	\top		1.8	acole periphy=>	1.2	}		-
Prepare to Move Off-Site Transportation Casi: From SF	2					19.7	39.4	4
Prepare to Move Official flux spots	60	60		Operators	2		0.5	-2
Storage Yard		60		Prime Mover Operator	15	0.5	0.5	
		60		Crane Operator	20	8.7	8.7	
والمراب		60		Radiation Protection	10	8.7	20.3	-4
Perform Shipping HP Survey Coak(s: periphery)	70	70		Operators	10	0.5	0.6	- 2
, Penam sriporo ni asto)		70		Prime Mover Operator		0.5	0.6	2
		70		Crane Operator	20	43	50.2	
		70		Radiation Protection	2	43	143	
Decontaminate Cosk (carea)	110	10		Operators	2	0.5	0.1	_
		10		Prime Mover Operator	15	0.5	0.1	_
reeded)		10		Crarie Operator	20		1.5	_;
		10		Radiation Protection	2	43	100.3	4
1 Install Cask Redraints (speriphery)	70	70		Operators			0.6	
1 FRICE COR ROBIGISTA		70		Prime Mover Operator	20		0.6	-
		70		Crane Operator	10		10.2	- 3
		70		Radiation Protection	10/2		157.7	
. Install Impact Limiters (scalameter -area)	110			2 Operators			0.9	
. PROFITACIONAL		110		Prime Mover Operator	20		0.9	
		110		1 Crane Operator	10		16.0	
		110		1 Rodiction Protection	- "		50.2	
Install Personnel Barrier (s. periphery)	35		_	2 Operators			0.3	
		35		1 Prime Mover Operator	2		0.3	Г
		35		1 Crane Operator	10		5.1	
		35		1 Radiation Protection	1 7		0.0	
Open Receiving and Shipping Bay Door, simultaneou	BA MED F	0		1 Operator 1 Prime Mover Operato			0.1	
72. Httch Site Prime Mover				1 Operator	+	0		
- Propose Shipping PODES	20			2 Operators	10		29	
Contract Contract April 6000		1 10		1 Prime Mover Operato	7	5 0.5	0.1	
Come arms and section beackground dose some as crutie an	- (- 1	1 10	_	1 Crone Operator	2	0.5		
(casume rull background while moving)		+-10		1 Radiation Protection	10			_
	-+	 - '	_	2 Security Officers	1	2 17		_
h1 Perform Security check		3	_	2 Operators	10			
L Unhitch On-Site Prime Mover	-+	╀─┋	_	1 Prime Mover Operato	y 1			
	E) 6		-	2 operator-rail	1			
Make-up with other cask can per train (assume 3 ca	133 O	-	_	2 Operators	1	0 8.7		-
k. Hisch Otf-Site Prime Mover			3	1 Prime Mover Operato	7 1	5 0.5	0.0	
R HER CHARLET MINE	4						492.4	11 3

Table A1-3. Utilities-MPU

	· · · · · · · · · · · · · · · · · · ·			Roll mrem/hr		Backgrou	~1	
ofal Dases per Cask Handling for MPU at the UTS	Direct	Bkgd	SUTI	Lid doses		mrem/hr	~	
June 1994/nwg	(Denon-ri			Inner	220		ರಣಾ	
oad MPU for Shipping	1,424		1,495			crane	0.25	
Steps - (1,2,4,5,5,7,9)	 	 		Tp/fix cosk lid		decon	1	
oad MPU for Shipping with Transfer	 	 		Lateral San	59	pool	3	
Steps - (1,3,4,5,6,7,8,9)	2,002	04	2,096	Storage cask mrem/hr		ISPSI	2	
(1.4 446461) - 696	 	 		Ud doses				
- 14 TO 14 - 17	 	 		Inner	220		0	
oad MPU for Storage	1,565	70	1,743		97			
Steps - (1.2.4.5.6.7.10)	1	 	1,5	To/fix coak lid	70			
	 			Lateral San	70			
oad MPU for Storage with Transfer	2.243	100	2.344					
Steps - (1.3.45.6.7.8.10)	 	- ''-						
Millian dames for descript	 	 						
romer MPU from storage for shipping	798	57	855					
Steps - (11,12)	\ 	 						
	 							
Cask Handling Operations	Teta Tak Time(Aft.)	Dose fine(Afr.)	Personnel Requirements (Persons (Toxic)	Occupation	WorldingDistance(Feet)	Cask Dose Rote(mrem hr)	Base Dose Received(Perparement)	Frofft das bodows and (name mount)
				asume prep has arane		James and		
1. Receive Empty MPU	10	10	 -	Operator	0	0	0.0	Q.
 Impect Bills of Loding, Other Shipping Papers 				Prime Mover Operator	15			O.
b. Take MPU to Warehouse	60			Operators	10			Q.
c. Up and MPU of Warehouse and Store	x	30		Crane Operator	20			a.
					15			a
d. Release Off-Site Prime Mover (PM)	10			Prime Mover Operator	15			0.1
e. Hitch On-Site PM	10			Pitrie Mover Operator				61
Move MPC to Protected Area	2			Prime Mover Operator	15			
g. Security inspection	X			Security Officers	2			0.
h. Open Staging Area Door				Operator	15			a
L. Move MPU to Prep Area	30			Prime Mover Operator				0.3
j. Perform Preliminary HP Survey of MPC	4			Radiation Protection	2			0.0
k. Attach Utting Device to MPU	1			Operators	10			
		5		Ragman	20			_
		5		Crone Operator				
k1.Close Staging Area Door, simultaneous		5		Operator	10			
L LIST MPC Into Prep Area	30			Operators	20			
	I	30		Crane Operator		 	0.0	
Total		366	 					
		 	 				 	
2. Receive Unloaded Universal-	+	+	+	assume prep has arane	COC IV	koro nel	t	_
overpack (MPU)	10	10		Operator	0		0.0	0.0
a. Inspect bills of Loding. Other Shipping Papers	1 1			Prime Mover Operator				0.0
b. Release Off-Site PM	1 70			Prime Mover Operator				
c. Hich On-Site PM	- "			Radiation Protection	2			_
d. Perform Receipt HP Survey	2			Prime Mover Operator				
Move Cask to Protected Area				Security Officers	1 2			
f. Security inspection	3			Operator	- 6			
g. Open Staging/Area Door		5		Prime Mover Operator				
		A		THE SHOWEN CHECKER	, <u>19</u>			
h. Move Cask to Prep Area	3			Conservations				
h. Move Cask to Prep Area L. Remove Personnel Barrer/Impact Limiters		0 90	2	Operators	10		00	U
h. Move Cask to Prep Area L. Remove Personnel Barner/Impact Limiters	9	0 90) 2	Crane Operator	10	0		
h. Move Cask to Prep Area L. Remove Personnel Barner/Impact Limiters J. Class Staging Area Door	9	0 90 90 8 4	1	Crane Operator Operator	10	0	0.0	ac
h. Move Cask to Prep Area L. Remove Personnel Boner/Impact Unifiers J. Close Staging Area Door k. Remove Cask Restraints	39	0 90 90 5 5 0 60		Crane Operator Operator Operators	10	0	0.0	0.5
h. Move Cask to Prep Area L. Remove Personnel Barner/Impact Limiters J. Class Staging Area Door k. Remove Cask Restraints L. Perform Preliminary HP Survey	3 9 6 4	0 90 90 5 5 0 60 0 40) 2) 1 5 1 2 2	Crane Operator Operator Operators Rodation Protection	10	0 0 0	0.0 0.0	0.0 0.2 0.2
h. Move Cask to Prep Area L. Remove Personnel Boner/Impact Unifiers J. Close Staging Area Door k. Remove Cask Restraints	3 9 6 4	0 90 90 6 0 60 0 40 5		Crane Operator Operator Operators Radiation Protection Operator	10	0 0	0.0 0.0 0.0	0.5 0.5 0.3
h. Move Cask to Prep Area L. Remove Personnel Barner/Impact Limiters J. Class Staging Area Door k. Remove Cask Restraints L. Perform Preliminary HP Survey	3 9 6 4	0 90 90 6 8 0 60 0 40 5 8) 2) 1 5 1 2 2 5 1	Crane Operator Operator Operators Rodiotion Protection Operator Operator	10	0 0 0 0	0.0 0.0 0.0 0.0	0.0 0.1 0.1
h. Move Cask to Prep Avea L. Remove Personnel Barner/Impact Unities J. Class Staging Area Door k. Remove Cask Restraints L. Perlam Preliminary HP Survey m. Engage Yoke to Cask	3 9	0 90 90 6 5 0 60 0 40 5		Crane Operator Operator Operator Radiotion Protection Operator Operator Operator	10	000000000000000000000000000000000000000	0.0 0.0 0.0 0.0 0.0	0.00 0.00 0.00 0.00
h. Move Cask to Prep Area L. Remove Personnel Barrer/Impact Limiters J. Class Staging Area Door k. Remove Cask Restraints L. Perform Preliminary HP Survey	3 9	0 90 90 6 9 0 60 0 40 5 1		Crane Operator Operator Operators Radiation Protection Operator Operator Operator Operator Operator	10 20	000000000000000000000000000000000000000	0.0 0.0 0.0 0.0 0.0 0.0	0.0 0.1 0.1 0.1 0.1
h. Move Cask to Prep Area L. Remove Personnel Barner/Impact Unitiers J. Close Staging Area Door k. Remove Cask Restraints L. Perform Preliminary HP Survey m. Engage Yoke to Cask	30 99 99 99 99 99 99 99 99 99 99 99 99 99	0 90 5 90 6 60 0 40 5 9	2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Crane Operator Operator Operator Radiotion Protection Operator Operator Operator	10	000000000000000000000000000000000000000	0.0 0.0 0.0 0.0 0.0 0.0	0.0 0.1 0.1 0.1 0.1 0.1
h. Move Cask to Prep Area L. Remove Personnel Barner/Impact Unitiers J. Close Staging Area Door k. Remove Cask Restraints L. Perform Preliminary HP Survey m. Engage Yoke to Cask	3 9	0 90 5 90 6 60 0 40 5 9	2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Crane Operator Operator Operators Radiation Protection Operator Operator Operator Operator Operator	10 20	000000000000000000000000000000000000000	0.0 0.0 0.0 0.0 0.0 0.0	0.0 0.2 0.0 0.0 0.0 0.0
h. Move Cask to Prep Area L. Remove Personnel Barrer/Impact Limiters J. Close Staging Area Door k. Remove Cask Restraints L. Perform Preliminary HP Survey m. Engage Yoke to Cask n. Lift Cask Into Prep Area Total	30 99 99 99 99 99 99 99 99 99 99 99 99 99	0 90 5 90 6 60 0 40 5 9	2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Crane Operator Operator Operators Radiation Protection Operator Operator Operator Operator Operator	10 20	000000000000000000000000000000000000000	0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 0.2 0.0 0.0 0.0 0.0
h. Move Cask to Prep Area L. Remove Personnel Borner/Impact Limiters J. Class Staging Area Door k. Remove Cask Restraints L. Perform Preliminary HP Survey m. Engage Yoke to Cask n. Lift Cask Into Prep Area	30 90 60 4	0 90 5 90 6 60 0 40 5 9	20 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Crane Operator Operator Operators Radiation Protection Operator Operator Operator Operator Operator	10 20	000000000000000000000000000000000000000	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 0.0 0.0 0.0 0.0 0.0 0.0

Table A1-3. Utilities-MPU (continued)

						<u> </u>	
		60		Crane Operator		0 0.0	
		60	116	Radiation Protection		0 0.0	
b. Relicae PM	5	5		Operators		0 0.0	
D. KOOCOTTIN		5		Prime Mover Operator		0 0.0	_
		5	310	Crane Operator		0.0	
		5	1(1	Radiation Protection		0 0.0	
17 1 00 000 000	10	10		Operators	10	0 0.0	0
c. Harch On-Site PM		10		Prime Mover Operator	15	0.0	0
		10		Crane Operator		0.0	_
						0 0.0	_
		10		Radiation Protection			
d. Move Cosk to Protected Area	20	20		Operators		0 0.0	
d acres de la constant de la constan		20	11	Perne Mover Operator		0 0.0	+
		20	110	Crane Operator		0.0	<u> </u>
		20		Radiation Protection	10	0 0.0) _ (
	30	30		Security Officers	2:	0 0.0	N C
Security Inspection				Operator		0.0	
1. Open Prep Dodr	5	5			15	0 0.0	_
g. Move Cask Into Prep Area	30	30		Prime Mover Operator		0 0.0	_
h Delocae PM	5	5		Prime Mover Operator	<u>15;</u>		
L Close Prep Areti Door (use decon background)	5	5		Operator		0 0.0	
j. Perform Preliminary HP Survey	40	40	21	Radiation Protection	2!	0 0.0	
1 Perioditi Presidente Cont	60	60	2	Operators	2:	0.0	
k Decontaminate Cask	60	60		Operators	2:	0 0.0	1 2
L. Remove Cask Restraints	40	40		Radiation Protection		0 0.0	1
m. Perform HP Sulvey					21	0 0.0	_
n. Decontaminale Cask	60	60		Operators	2	0 0.0	-
o. Engage Yoks to Cask	5	5		Operator	101	0 0.0	_
		5		Operator		0 0.0	_
		5		Crane Operator	20:		_
p. Lift Cask into Prep Area	25	25		Operators	10	0 0.0	_
J. J. Carrier 1. 1977		25	1	Crane Operator	20	0 0.0	_
	460	760				0.0))
tal:							L
							Γ
							1
Load MPC into Universal - er							1-
Transfer-overpack			!		2,	0 0.0	1
Align MPC with Clark	10			Operator		0 0.0	_
		10		Operator	10		_
		10	1 <u>j</u>	Crane Operator	20		_
Lower MPC into Cosk	20	20	2	Operators	2.	0 0.0	-
LOWER WAS COMMON TO THE PERSON OF THE PERSON		20	1	Operator	10	0.0	_
		20	1	Crane Operator	20'	0.0	
Librar Dayton Corpo MOC	10			Operator	2	0 0.0	
Disengage and Remove Litting Device From MPC	- ''	10		Operator	30	0 0.0)
				9-6-6		0.0	5
		10		Operators	2	0 0.0	3
1 Verily MPC Configuration for SNF	10				2	0 0.0	
FB Armulus with Demineralized Water	30			Operators	2	0 0.0	
Install MPC Conficinington Protection	30			Operators		0 0.0	_
Connect Annulus Floct Hotes	5	5		Operators	2.		_
REMPC With Water	60	60	2	Operators	22		_
oral .	175	245			<u>i</u>	0.1	<u> </u>
<u> </u>	T				i		1
	 					<u> </u>	1_
Prep MPC/Universal or		1		· · · · · · · · · · · · · · · · · · ·		!	1
MPC/Transfer for Pool	10	10		Operator	2	0 0.1	0
2. Attach Cask Yoke to Crane	10	10		Rogman	10	0 0.	
						0 0	_
	<u> </u>	10		Crane Operator	20	0 0.	
s. Engage Voke to Cask	25			Operator			
	<u> </u>	<u>2</u> 5	1	Ragman	10.	0 0.0	_
4		25		Crane Operator	20	0 0.0	_
. Move Cask to Ruel Loading Pool Roor	30	30	2	Operators	10.	0 0.0	-
THE CASE IN COLUMN SALES AND ASSESSED.	1	30		Crane Operator	20.	0 0.0	_
Notes From Cords	20			Operator	30	0 0.	_
d. Deengage Yoke From Cask	 	20		Ragman	30	0 0.	0
	+	20		Crane Operator	: 40	0 0.	0
	+			Operators	10	0 0.	
Remove Yoke From Pool	10				10	0 0.	
	 	10		Rogman	20	0 0.	_
		10		Crane Operator	 ~	- 0	
otal	96	265	!	<u>!</u>	<u> </u>	- "	╃-
	<u> </u>	1	<u> </u>	1	<u> </u>		+-
i. Load SNF into MPU/Universal	1		1	!	<u> </u>		
or MPU/Transfer	1	1	Ĭ	1	<u> </u>		+
OF MITU/ ITEMPE	10	10	2	Operators	20	0.5 0.	
a. SNE Grapple Attached to Crane	 '	 	† -	1		0.	0
b. Engage One SNF Assembly, (12 min, per assembly)	+	250	1 -	Operators	20	0.5 4	2
b1. Time for 4 element cosk	250						2
c. Load SNF Into MPU	7			Operators	+		5
	330	330	!		+		7
lotal			1	1	!		+-
lotal			↓				
							
Total 7. Prep MPU/Universal or MPU/I ansier from pool					2	0 0	.0

Table A1-3. Utilities-MPU (continued)

					10:		0.0	_
		5		Crone Operator	20:	- 0	0.0	
	20	20		Remote	0		0.0	-
n Install MPU Shield Plug	5	5		Operator	30	ol	0.0	
: Engage Yake to Cask		- 5		Ragmon	30:	0	0.0	
		5		Crane Operator	40;	0	0.0	
The second of th	5	5		Occasolors	10r	0	0.0	
Litt MPU/Cask to Pool Surface		5		Crane Operator	20;	0	0.0	
The Prince Patrices	10	10		Operator	2	220	36.7	_
install Shield Plug Retainers Lift MPU/Cask into Prep/Decon Area	30	25		Operators	10	11	9.2	_
LET MPU/CORK END PIEC/DECUTARED		30		Crane Operator	20.	0.5	0.3	_
	5	5		Operator	2	59	49	_
Disengage Yoke from Cask		5		Rogman	10'	11	0.9	_
		5		Crone Operator	20:	0.5	0.0	_
	10	10		Operator	2:	220	36.7	_
Remove Shield Plug Retainers	120	90		Operator	10	111	16.5	-
Decon MPU/Calk and Yake	120	40		Crone Operator	20 _i	0.5	0.3	_
	10	10		Operator	2	220	36.7	_
Hook Up Drain Equipment	20	20		Operator	10	11	3.7	_
Partially Drain MPU and Annulus	10	10		Operators	2:	220	73.3	
Remove Annulus Sedi	30	10		Radiation Protection	2:	59	19.7	_
n. Chack MPU/Cask for Conformination		10		Operators	2	220	73.3	
n Install Annuals Welding Protection	10			Welder	2	220	110.0	
o. Install Remote Welding Equipment	45	30		Crore Operator	20	0.5	0.1	_
		10		Remote	01	G	0.0	
o, thiner tid Weld	1000	0		CA Welder	2	220	73.3	_
Perform NDE on Weld	30	20		Weider	2	220	73.3	_
Remove Welding Equipment	20	20		Crane Operator	20:	0.5	0.1	_
		10			2:	220	30.7	_
Drain, Dry, and Inert MPU	350	10		Operator	10!	111	642	_
		350		Operator	21	220	36.7	_
t. Remove Drain, Dry, and Inerling Equipment	10	10		Operator	2,	37	12.3	-
u. Perform Leak Tests on Seal Weld	20	20		Operator	2:	220	330.0	_
v. Weld Valve Cover Plates	80	90		Welder		97	16.2	_
w. Place MPU lid	20	10		Operator	10:	- 11	1.8	_
		10		Rogmon		0.5	0.1	
		10		Crane Operator	20		48.5	
x. Set Up Remote Welding Equipment	45	30		Weider	2	97	0.1	
		10		Crane Operator	20:	0.5	0.01	_
y. Weld MPU Lid	1000	0		Remote	O;	- 0		_
z. Perform NDT on Weld	30	20		CA Welder	2;	97	32.31	_
go, Remove Annulus Weld Protection	10	10		Operator	21	97	16.2	_
bb. Place Cask tid	10	10		Operator	2,	70	11.7	_
		10		Rogman	10.	11	1.8	_
		10		Crane Operator	20	0.5	59.0	_
ec. Decon Cask	30	30		Operators	2,	59		_
		30		Crane Operator	20	0.5	0.3	
dici. Perform HP Survey	45	20		Radiation Protection	21	59	39.3	
ee. Secure Cast Bolted Lid	60	60		Operators	2,	70	140.0	
otal	3105	1180					1,416	
								_
B. Transfer MPU from Transfer-		!	·					_
overpack to Universal				I				ļ.,
overpock	i						إ	_
a. Open Staging Area Door	5	0		Operator	0	0	0.0	
b. Move On-Site PM and Transporter to Staging Area	10	10		Prime Mover Operator	15	0	0.0	_
U. HOLD WILLIAM TO THE STREET		10		Transporter Operator	15	0	0.0	_
c. Unhitch On-Ste PM	5	5		Prime Mover Operator	15	0	0.0	
d. Engage Yoke to MPC/Cask	10	10		Operator	2	17	2.8	_
G. Bibabe tone Suit clook		10		1 Ragman	10:	8.7	1.5	_
		10		I Crane Operator	201	0.5	0.1	
d1. Close Staging Area Door, simultaneously with Step of	d.	O		1 Operator	0	0	0.0	_
e. Place MPC/Calk on transporter	45	451		Operators	10.	8.7	13.1	•
A. Live in State of the second		45		1 Crane Operator	20	0.5	0.4	-
f. Perform Release HP Survey	60	30		2 Radiation Protection	2:	50	59.0	•
g. Install Cask Restraints	60	60		2 Operators	2	32	64.0	•
h. Open Prep Area Door	5	0		1 Operator	0.	0	0.0	•
i. Prepare Transfer Papers	10	0		1 Operator	0.	0	0.0	•
j. Move MPC/Cask Outside Protected Area	10	10		Prime Mover Operator	15	0.5	0.1	
k. Move MPC/Cask to Transfer Area	60	30		2 Operators	10	8.7	8.7	•
		30		Prime Mover Operator	15	0.5	0.3	_
	1	30		1 Crane Operator	20	0.5	0.3	•
	1	30		1 Radiation Protection	10	8.7	44	_
	60			2 Operators	2	70	70.0	-
A President Cost for MPC Investor				1 Prime Mover Operator	15	0.5	0.5	ı
Prepare Cask for MPC Transfer	 	J An					0.5	ı
Prepare Cask for MPC Transfer	!	60		1 Crane Operator	20	0.5	0.5	-
Prepare Cask for MPC Transfer		60		1 Crane Operator 1 Radiation Protection	10:	11	11.0	-
		60		1 Radiation Protection				Ĺ
Prepare Cask for MPC Transfer m. Engage Crane to MPC Lift Attachment	10	60			10:	11	11.0	I

Table A1-3. Utilities-MPU (continued)

				· · · · · · · · · · · · · · · · · · ·		97	16.2	ā
Verify Vertical Alignment of MPC to Storage Cask	10	10		Operator	<u> </u>	- 7/	0.0	- 0
Clear Operators to a Shielded Area	5	0		Operators Operator	01	ol	0.0	0.
1 Close Increter Room Doors	30			Remote	0:	0	0.0	0.
Point MPC from Storage Costs	5			Remote	O1	0	0.0	٥
Move MPC Over Tromport Cosk	10	- 6	_	Remote	0	0	0.0	0
Verify Vertical Alignment of MPC to Transport Cask	20	- 0	O	Remote	0i	0	0.0	0
Correct Vertical Alignment	30	o	O	Remote	0:	0	0.0	0
Lower MPC into Transport Cask		0	0	Remote	0!	0	0.0	0
Copen Transfer Room Doors Radiation and Conformation Survey	10	10	2	Radiation Protection	21	43	14.3	0
Remove MPC Lift Affactment from MPC	30	20	2	Operators	2	97	64.7	0
Remove MPC UIT ATTOCHER ITOTT ATTOCHER		15	1	Ragman	10'	8.7	22	0
		15	1	Crane Operator	20	0.5	0.1	0
Disengage Crane from MPC Lift Attachment	10	5	1	Operator	2!	39.4	33	-6
Daengage Cici e II dili wa Garia		10		Ragman	10:	3.7	0.1	
		10		Crane Operator	20	97	16.2	- 0
Place Craix Ud	10	10		Operator	21		1.5	-
71000 COM 007		10		Ragman	10	0.5	0.1	_;
		10		Crone Operator	20	59	59.0	
Decon Cask	30	30		Operators	2: 20'	0.5	0.3	7
Decerious.		30		Crone Operator	2	59	39.3	_;
Perform HP Survey	45	20		Radiation Protection	2	50	118.0	
n. Secure Cosk Bolteci Lid	60	60	2	Operators			578.2	12
lai .	£10	695						
Prep MPU/Universal-					<u> </u>			_
overpack from Pool Prep for shipping	- 5			Operator	O:	0	0.0	. (
Cons Stanion Ares Door	10	10		Prime Mover Operator	15:	0.5	0.1	
Move On-Site PM cand Otf-Site Transporter to Prep Are	5	5		Prime Mover Operator	15.	0.5	0.0	
Unhitch On-Site PM	10	10		Operator	2.	17	2.8	(
Engage Yake to MPU/Cask		10		Rogman	10!	8.7	1.5	
				Crane Operator	20!	0.5	0.1	
		- 10		Operator	O'	0	0.0	
d1. Close_Prep Arect Door, simultaneous	45	45		Operators	10:	1.8	2.7	
. Race MPU/Cask on Transporter		45		Crane Operator	20:	0.5	0.4	
	80	35		Radiation Protection	2:	43	50.2	
Perform Shipping HP Survey	35	35		Operators	21	32	37.3	
Neutron Shields and Install Cosk Restraints		35		Crone Operator	20	0.5	0.3	
	55	55	2	Operators	2	32	58.7	
nstal impact Limiters		55	1	Crane Operator	20	0.5	0.5	
The state of the s	70	70		Operators	2	32	74.7	
trisfalt Personnel Barrier		35		Crane Operator	20:	0.5	0.3	_
D Chinaina Divisa	10			Operator	0,	0	0.0	_
Prepare Shipping Propers Copen Stoging Area Door	5	0		Operator	0'	0.5	0.0	_
Hisch On-Site PM	5			Prime Mover Operator	15	0.5	0.3	_
m. Move Cosk/MPU Cutside Protected Area	30			Prime Mover Operator	15:	17	3.4	
Perform security chisck	5			Security Officers	15,	0.5	30	_
1 Univided Co-Site PM	5	+		Prime Mover Operator	15.	1.2	2.4	_
2. Make-up with other cosk cars per train (assume 3 car	60			Operator-rai		0.5	0.0	
o. Hitch Off-Sile PM		5		Prime Mover Operator	1 13		235.6	
otal	440	565	<u> </u>	ļ	 			_
		ļ	i		 			
0. Prep MPU/Universal-overpack			├	 	 			
from Pool prep for ISFSI		-	ļ	Operator	1 0	0	0.0	
e Onen Pren Aren Door	5			Prime Mover Operator		0	0.0	
b. Move On-Site PM and Transporter to Stoging Area	10	10		Transporter Operator	15	٥	8.0	
	; 			1 Prime Mover Operator		0	0.0	
c. Unhitch On-Site PIA	+ 10			Operator	2.	37	6.2	
d Engage Yake to IMPU/Cask	 	1-10		1 Rogman	10	8.7	1.5	
		10	_	1 Crane Operator	20.	0.5	0.1	_
		 		1 Operator	0.	0	0.0	_
d1. Close Prep Areci Door, simultaneous	+ 4			2 Operators	10	8.7	13.1	_
Place MPU/Cask on Transporter		1 2		1 Crane Operator	20	0.5	0.4	
40.50	1 4	_		2 Radiation Protection	2'	59	59.0	_
f. Perform Refectse HP Survey	- 6		_	2 Operators	2:	32	64.0	-
g. Install Cask Restraints				1 Operator	0	0	0.0	-
h Open Prep Ared Door				1 Coerctor	0:	0	0.0	-
L Prepare Transfer Papers j. Move MPU/Cask Cutside Protected Area	1		0	1 Prime Mover Operato	r 15	0.5		_
MOVE MPUTCOR CAUSED FIORCISC AND	1 0		_	2 Operators	10.	8.7	8.7	_
k. Move MPU/Cask to ISFSI	1	3		1 Prime Mover Operato		0.5		-
(null background done while moving)	1	3	_	1 Crane Operator	20	0.5		_
	1	3	0	1 Radiation Protection	10	8.7		-
	1 2		0	2 Operators	2,			_
. the area Code from Instantion			A1	1 Transporter Operator	15	0.5		_
L. Unsecure Cosk from Transporter		2	UI					
L. Unsecure Cask from Transporter (ISFS background dose)			0	1 Rediction Protection	10	8.7		_
Unsecure Cask from Transporter (ISFSI background dose) m. Place Cask on Pad		1			10	59	59	

Table A1-3. Utilities-MPU (continued)

		30	1	Radiation Protection	10:	8.7	4.35	1.
n. Return Transport to Transfer Facility	50	25	2	Operators	10'	0	0	Q.
(rull background while moving and no casis)		25		Transporter Operator	15	0	0	Q.
THE DOOK FOUND WHEN HOW & BUILD COMP		25		Radiation Protection	10	0	0	0.
	410	400					242.9	8.
lotal							i	
11. Move MPU from ISFSI slorage								
c. Get Transport from Transfer Facility	50	25	2	Operators	101	0	<u>o</u>	0.
1 001 100 100 100 100 100 100 100 100 1		25	1	Transporter Operator	15 _i	0	0	Q.
		25	3	Radiation Protection	10:	0	0	0.
b. Raise Cask from Pad	60	30		Operators	2	59	59	2
(SFS background dose)		60	1	Transporter Operator	15	0.5	0.5	2
,sis total of some		30	1	Radiation Protection	10;	22	11	1.
c. Move MPU/Cosk, from ISFSI	60	30	2	Operators	10	8.7	8.7	2
C. MOVE WE DICCORC, NOTE DE CO		30	1	Prime Mover Operator	15	0.5	0.3	1.
		30		Crane Operator	20	0.5	0.3	1.0
		30	ï	Radiation Protection	10	8.7	44	1.
The second secon	20	10	2	Operators	2	59	19.67	Q.
d. Ursecure Cosk from Transporter		20		Transporter Operator	15	0.5	0.17	Q,
(ruli background dose)		10		Radiation Protection	10)	22	3.67	0.
the territories to The	50	50	1	Transport Op.	15:	0	0.00	0.
e. Return transports: to transfer facility	190	356			i		440.4	25.
Total	- 1,70							
12. Prop MPU/Universal from storage to shipping						يلب		
(derived from Steps of 5b, roll, of UTS-RDS spreads/seet)				casume SFS bookground	dose, exce	or or ro	siding	
g. Perform Release HP Survey(s -clameter)	80	49		Radiation Protection	21	43	57.3	2
b. Install Nuetron Shield and Cask Restraints	99	90		Operators	2'	43	129.0	6.
0.1010		90		Prime Mover Operator	15	0.5	0.8	3.1
		8		Crane Operator	20	0.5	0.8	3.
		90		Radiation Protection	10:	19.7	29.6	3.
c. Install Impact Limiters(s-diameter)	55	55		Operators	21	32	58.7	3.
C. 8 C. C. T. D. C.		55		Crane Operator	201	0.5	0.5	1.
d. Instal Personnel Basier(s-perimeter)	70			Operators	2	32	74.7	4
d lad radio		35		Crarie Operator	20:	0.5	0.3	_1,
e. Prepare Shipping Papers	10	0		Operator	0	0	0.0	0.0
t. Open Prep Area Door	5	0		Operator	0.	0	0.0	0.0
a. Hitch On-Site Prime Mover	5	5		Prime Mover Operator	15	0.5	0.0	0.
h. Move Cask to Protected Area Gate (rull background a	30	30		Prime Mover Operator	151	0.5	0.3	1.1
Perform security check	5	5		Security Officers	21	17	3.4	0.0
L Un-hitch On-Site Prime Mover	5	5	1	Prime Mover Operator	15	0.5	0.0	0.
k. Make-up with other cask cars per train (assume 3 cars)	60	60		Operatornal	15 i	1.2	2.4	0.
L Hitch Off-Site Prime Mover (assume rall siding dose same	5	5	1	Prime Mover Operator	151	0.5	0.0	0.0
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Table A1-4. Utilities-MPC

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3	Ю	30 ;	1 Prime Mover Operato							ol a
	10	40	2 Radiation Protection		_					
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		60	2 Operators 1 Prime Mover Operat 1 Crane Operator	or	15 20	0	0.0 0 0.0 0	3	1 (0.0
		60	2 Operators 1 Preme Mover Operat	or	15	0 0	0.0 0 0.0 0 0.0 0	3	1 1	0.0
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Table A1-4. Utilities-MPC (continued)

		5		Crane Operator	20 10	의	8	88			0.
	10	5		Radiation Protection	10	0	-8	0.1	;		_
c. Hisch On-Sile PM	10	10		Operators Prime Mover Operator	15	ö	- 60		1		_
	╁╼┪	10		Crane Operator	20	Ö	0.0		1		_
	1	10		Radiation Protection	10	0	0.0	0.0	1	0.0	Q
at Alama Carlota Bridge Hard Armo	20	20		Operators	10	0	0.0	0.2		0.0	0.
d. Move Cask to Protected Area	1	20		Prime Mover Operator	15	0	0.0	0,1	1	0.0	
	1	20		Crane Operator	20	0	0.0	0.1	1	0.0	
	1	20	-1	Radiation Protection	10	0	0.0	0.1	1	0.0	
e. Security Inspection	30	30	2	Security Officers	2	0	DO.	0.3	1		_
Open Prep Door	5	5	1	Operator	1	0	0.0	0.0			-
Move Cask into Prep Area	30	30	1]	Prime Mover Operator	15	0	0.0	0.0			
Release PM	5	5	1	Prime Mover Operator	15	0	90	0.0			
Close Prep Area Door (use decan area background do	5	5	1	Operator		0	0.0	9.1	1	0.0	_
Perform Preiminary HP Survey	40	40	2	Radiation Protection	2	0	0.0	1.3	1		
Deconfaminate Cask(lew events)	60	60	_	Operators	2	0	0.0	20	0		-
Remove Cask Restraints	60	60		Operators	2	0	0.0	20			
Perform HP Survey	40	40		Radiation Protection	2	9	0.0	1.3	1	0.0	
Deconfaminate Caldrare event)	80	60		Operators	2	<u></u> 9	_00	20	Ŷ		
Engage Yake to Calk	5	5		Operator	2	0	0.0	0.1		0.0	_
	1	5		Ragman	33	0	00		1	0.0	-
	1	5		Crane Operator	20 10	0	0.0	0.1	+	0.0	_
Ulf Conk into Prep Area	25	25		Operators	20	- 0	- 60	0.4	\vdash	0.0	-
	 	<u> ක</u>	-1	Crane Operator	ريم		- E.D		29.0		-
fat:	460	780					COLUMN TO SERVICE	- TABLE	<u> </u>	0.0	+
	4								Η-		+
				casume crone enclosur		i			<u> </u>		t
Load Empty MPC Into Transportation- or	╂╼╌╾┥			CHUIN GUIN STONE		<u> </u>			 		۲
ransier-overpock (no SNF present)	10	10	,	Coerator	2	0	90	0.0	1	0.0	1
Afgn MPC with Coak	1 10			Operator	10	0	- 60	0.0		0.0	٠
	+	10		Crane Operator	20	ő	00	0.0	i	0.0	
		10		Operators	2	0	0.0	0.2	1		
Lower MPC into Cask	20	20		Operator	10	Ö	0.0	0.1	i		
		20		Crane Operator	20	0	0.0	0.1	1		_
	1 10	10		Operator	2	- 6	0.0	0.0			_
Disengage and Remove Lifting Device From MPC		10		Operator	10	0	0.0	0.0	1		
	10	10		Operators	2	O	0.0	0.1	1		0
L Verity MPC Configuration for SNF	30	30		Operators	2	0	0.0	0.3	1		Г
. Fili Annulus with Demineralized Water	30	30		Operators	2	ō	0.0	0.3	1	0.0	
Install MPC Contamination Protection	1 5	5		Operators	2		0.0	0.0	1	0.0	C
Connect Annulus Roat Hoses	1 60	60		Operators	2	0	0.0	0.5	1	0.0	Ĺ
FE MPC With Woler	176	245					0.0	1.7	13.0	0.0	L
*d	+ ***	-									L
Prep Empty MPC/Ironsport or MPC/Ironster for Pool				casume crone creatrit	tolly						L
Affach Cask Yake to Crane	10	10	1	Operator	2		0.0	ao			_
L Ander Cost vote lo Cost	1	10	1	Ragman	10		0.0	0.0	_		
		10	1	Crone Operator	20)	0.0	0.0			_
a. Engage Yoke to Cask	25	25	1	Operator	2		0.0	0.1			
a. Engage Yoke to Cask		25	1	Rogman	10		0.0	0.1	1		•
		25		Crane Operator	20	0	0.0	0.1	!		
Move Cask to Fuel Loading Pool Roar	30	30		Operators	10		0.0		-!		
asume pool crea background)		30		Crane Operator	20		0.0		_		-
i. Disengage Yoke From Cask	20	20		Operator	30		0.0				
		20		Rogman	30	_					
		20	_	Crane Operator	40						
. Bernove Yoke From Pool	10			Operators	10		0.0				
		10		Rogman	10		0.0	-	_		
	4	10		Crane Operator	20	۳	0.0				
otal	95			 	1	-	- 40			1 0.0	+
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				 	20	0.5	0.2	1.0	1	0.2	T
or MPC/Ironslet	1-,	10		NCOOMICON .							-
er MPC/fransfer SNF Gracole Attached to Crane	10	10	3	Operators	 		מם	0.0	1		
or MPC/Transfer SNF Grappie Attached to Crane Engage One SNF Assembly, (12 min. per assembly)						0.5	42				
or MPC/Transfer SNF Grapple Attached to Crane Engage One SNF Assembly, (12 min. per assembly) b 1. Time for 4 element cosk	250	250	7	Operators	20			25.0	1	4.2	Ī
er MPC/Transfer SNF Grapple Attached to Crane Engage One SNF Assembly, (12 min. per assembly) b1. Time for 4 element cosk Load SNF Into MPC	250 70	250 70			20		42	25.0 7.0		1.2	
er MPC/Transfer SNF Grappie Attached to Crane Engage One SNF Assembly, (12 min. per assembly) b1. Time for 4 element cosk Load SNF Into MPC	250	250 70		Operators	20		12	25.0 7.0		1.2	
SNF Grapple Attached to Crane Engage One SNF Assembly, (12 min. per assembly) b1. Time for 4 element cosk Load SNF Into MPC otal	250 70	250 70		Operators	20		12	25.0 7.0		1.2	
er MPC/Iransfer SNF Grapple Attached to Crane Engage Cine SNF Assembly, (12 min. per assembly) b1. Time for 4 element cosk Load SNF Into MPC otal 7. Prep MPC/Iransportation or	250 70	250 70		Operators	20		12	25.0 7.0		1.2	
er MPC/Transfer SNF Grapple Attached to Crane Engage One SNF Assembly, (12 min. per assembly) b1. Time for 4 element cask Load SNF Into MPC otal 7. Prep MPC/Transportation or MPC/Transfer from poel	250 70 330	250 70 330		Operators Operators	20	0.5	4.2 1.2 8.5	25.0 7.0 33.0	4.0	4.2 1.2 5.5	
er MPC/Iransfer SNF Grapple Attached to Crane Engage Cine SNF Assembly, (12 min. per assembly) b1. Time for 4 element cosk Load SNF Into MPC otal 7. Prep MPC/Iransportation or	250 70	250 70 330		Operators Operators	20 20	0.5	1.2 1.2 5.5	25.0 7.0 33.0	4.0	4.2 1.2 5.5	
er MPC/transfer 2. SNF Grapple Attached to Crane 3. Engage One SNF Assembly, (12 min. per assembly) 5. Erne for 4 element cask 5. Load SNF Into MPC otal 7. Prep MPC/transportation or MPC/transfer from poet	250 70 330	250 70 330		Operators Operators	20 20	0.5	4.2 1.2 5.5 0.0	25.0 7.0 33.0 0.5 0.3	4.0	4.2 1.2 5.5 0.0 0.0	
er MPC/Iransfer SNF Gropple Attached to Crane Engage Crie SNF Assembly, (12 min. per assembly) b1. Time for 4 element cask Load SNF Into MPC otal Prep MPC/Iransportation or MPC/Iransfer from poet Attach MPC Shield Plug Ult Ridure to Crane	250 70 330	250 70 330 5 5 5		Operators Coperators Coperators Rogman	20 20 20 20	0.5	0.0 0.0 0.0	25.0 7.0 33.0 0.5 0.3 0.0	4.0	0.0 0.0 0.0 0.0	
er MPC/transfer 2. SNF Grapple Attached to Crane 3. Engage One SNF Assembly, (12 min. per assembly) 5. Erne for 4 element cask 5. Load SNF Into MPC otal 7. Prep MPC/transportation or MPC/transfer from poet	250 70 330	250 70 330 5 5 5 5 5		Operators Coperators Coperators Regimen	20 20 20 20 20 20 20 20 20 20 20 20 20 2	0.5	0.0 0.0 0.0 0.0	25.0 7.0 33.0 0.5 0.3 0.0 0.2	4.0	0.0 0.0 0.0 0.0 0.0	

Table A1-4. Utilities-MPC (continued)

d. Urt MPC/Cask to Pool Surface	5	5.	2 Operators	10						
	1	5	1 Crane Operator	20					36.7	
e. Install Shield Plug Retainers	10	10	1 Operator	10					9.2	
. Lift MPC/Calk into Prep/Decon Area	30	25	2 Operators 1 Crane Operator	20					1 03	_
background close for decon crea)	5	30	1 Operator	1 2				_	49	
p. Disengage Yoles from Cask	- 1	5	1 Rogman	10			_		0.9	
	1 -	5	1 Crone Operator	20					0.0	
	10	10	1 Operator	1 2						-
h. Remove Shield Plug Retainers	120	90	1 Operator	10		16.5				
Decon MPC/Cask and Yoke	1 101	40	1 Crone Operator	20						_
10 -1-12 Conda Condament	10	10	1 Operator	1 2					36.7	
Hook Up Drain Equipment	20	20	1 Operator	10		3.7				
k. Partially Drain MPC and Annulus	10	10	2 Operators	1 2				1	73.3	a
Remove Annului Seal m. Check MPC/Coak for Contamination	36	10	2 Radiation Protection	1 2		19.7				a.
n. Install Annulus Welding Protection	10	10	2 Operators	1 2		73.3	0.3	1	73.3	a.
o. Install Remote Welding Equipment	1 2	30	1 Welder	2		110.0	0.5	1	110.0	П
O. THE BRIDGE VISION COLUMN	1 -	10	1 Crane Operator	20		0.1	0.2	1	0.1	a
p. trier lid Weld	1000	0	0 Remote	0		0.0	0.0	1	0.0	
g. Perform NDE on Weld	30	20	1 QA Welder	2	220	73.3	0.3	1	73.3	Q.
r. Remove Welding Equipment	20	20	1 Welder	2	220	73.3	0.3		73.3	0
. Relieve West (Equation	1	10	1 Crane Operator	20	0.5	0.1	0.2			0.
s Drain, Dry, and iner! MPC	350	10	1 Operator	2	220	36.7	0.2	_		
8 0.00,00,000	1	350	1 Operator	10		64.2				_
t. Remove Drain, Dry, and Inerling Equipment	10	10	1 Operator	2		36.7				_
LL Perform Leak Tests on Seal Weld	20	20	1 Operator	2	_	123	0.3			
v. Weld Valve Cover Plates	90	90	1 Welder	2						_
w. Place MPC Outer Ltd	20	10	1 Operator	2		16.2				
		10	1 Rogman	10		1.8	0.2			
	1	10	1 Crone Operator	20		0.1				
x. Set Up Remote Weiding Equipment	45	30	1 Welder	2		48.5				_
	1	10	1 Crane Operator	20		0.1	0.2			٥
y. Weld MPC Outer Lid	1000	0	0 Remote	0		0.0	00			_
z. Perform NDT on Weld	30	20	1 QA Welder	2		323	0.3			
co. Remove Annulus Weld Protection	10	10	1 Operator	2		16.2	02			0
bb. Place transport/transfer Cask Ud	10	10	1 Operator	2			02			ä
		10	1 Rogman	10		1.8	0.2			a
	1	10	1 Crane Operator	20		59.0	1.0	_		-
cc. Decon Cask(always event)	30	301	2 Operators	20		33	36			-
	45	20	1 Crane Operator 2 Radiation Protection	2		39.3	0.7			_
dd. Perform HP Survey	1 8	40	2 Operators	1 2						-
ee. Secure Cask Balled Lid						1416				2
	I KINN	11203	1		•		40.7		1416.1	
Total	3105	1180	_	 		1014	20.7	-7.2	1416.1	\Box
	3106	1180		 		1,214	20.7		1416.1	
8. Transfer MPC from Transfer-overpack	3106	1180	casume grane books	ound do	se in i				1416.1	
8. Transfer MPC from Transfer-overpock to Transport-overpock	5		casume crane bodg	ound do		se bre	0 (370) (3		1416.1	
8. Transfer MPC from Transfer-overpack to Transport-overpack c. Open Prep Anic Door		0		0	0	0.0	0.0		1416.1	
8. Transfer MPC from Transfer-overpock to Transport-overpock	5	0	Operator Prime Mover Operator Transporter Operator	15 15	0	0.0 0.0 0.0	0.0 0.0 0.0			
8. Transfer MPC from Transfer-overpack to Transport-overpack c. Open Prep Area Door b. Move On-Ste PM and Transporter to Staging Area	5	0	1 Operator 1 Pinne Mover Operato	15 15 15	000	0.0 0.0 0.0	0.0 0.0 0.0			
8. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Area Door b. Move On-Site PM and Transporter to Staging Area c. Unfitch On-Site PM	5 10	0 10 10	Operator Prime Mover Operator Transporter Operator	15 15 15 1 15	0 0 0 0	0.0 0.0 0.0 0.0 2.8	0.0 0.0 0.0 0.0			
8. Transfer MPC from Transfer-overpack to Transport-overpack c. Open Prep Area Door b. Move On-Ste PM and Transporter to Staging Area	5. 10	0 10 10: 5: 10	1 Operator 1 Piene Mover Operator 1 Ingraporter Operator 1 Piene Mover Operator 1 Operator 1 Ragman	15 15 15 1 15 2	0 0 0 17	0.0 0.0 0.0 0.0 2.8 1.5	0.0 0.0 0.0 0.0 0.0			
8. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Area Door b. Move On-Ste PM and Transporter to Staging Area c. Unintah On-Site PM d. Engage Yoles to MPC/Cask	5. 10	0 10 10: 5i	Operator Prime Mover Operator Transporter Operator Prime Mover Operator Prime Mover Operator Operator	15 15 15 1 15	0 0 0 17	0.0 0.0 0.0 0.0 2.8 1.5	0.0 0.0 0.0 0.0 0.0 0.0			
8. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Area Door b. Move Cin-Ste PM and Transporter to Staging Area c. Unitide Cin-Ste PM d. Brigage Yoke to MPC/Cask d1. Close Prep Area Door, struttaneously with Step d.	5 10	0 10 10 5 10 10 10	1 Operator 1 Pisne Mover Operator 1 Transporter Operator 1 Pisne Mover Operator 1 Operator 1 Ragman 1 Crans Operator 1 Operator	15 15 15 16 2 10 20	0 0 0 17 8.7 0.5	0.0 0.0 0.0 0.0 2.8 1.5 0.1	0.0 0.0 0.0 0.0 0.0 0.0			
8. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Area Door b. Move Cin-Ste PM and Transporter to Staging Area c. Unitide Cin-Ste PM d. Engage Yoles to MPC/Cask	5. 10	0 10 10 5 10 10 10 10	1 Operator 1 Prime Mover Operator 1 Transporter Operator 1 Prime Mover Operator 1 Prime Mover Operator 1 Operator 1 Ragman 1 Crane Operator 1 Operator 2 Operators	15 15 15 16 2 10 20 0	0 0 0 17 8.7 0.5	0.0 0.0 0.0 0.0 2.8 1.5 0.1 0.0	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0			
8. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Area Door b. Move On-Site PM and Transporter to Staging Area c. Unfitch On-Site PM d. Engage Votes to MPC/Cask d1. Close Prep Area Door, structaneously with Step d. e. Place MPC/Cask on Transporter	5 5 10 10 10 45	0 10 10 5 10 10 10 0 45	1 Operator 1 Pitne Mover Operator 1 Itaraporter Operator 1 Pitne Mover Operator 1 Operator 1 Corare Operator 1 Operator 2 Operator 1 Operator 1 Operator 1 Operators 1 Operators 1 Operators	15 15 15 16 2 10 20 0 10 20	0 0 0 17 8.7 0.5 0 8.7	0.0 0.0 0.0 0.0 2.8 1.5 0.1 0.0 13.1	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0			
B. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Area Door b. Move On-Site PM and Transporter to Staging Area c. Untritch On-Site PM d. Engage Yoke to MPC/Cask d1. Close Prep Area Door, structionsously with Step d. e. Place MPC/Cask on Transporter f. Perform Release HP Survey	5 10 6 10 45	0 10 10: 5: 10 10: 10: 0 45: 45: 30	1 Operator 1 Prime Mover Operator 1 Incraporter Operator 1 Prime Mover Operator 1 Operator 1 Ragman 1 Crane Operator 1 Operator 2 Operators 1 Crane Operator 2 Operators 2 Radiotion Protection	0 15 15 15 1 15 1 10 10 10 10 10 10 10 10 10 10 10 10 1	0 0 0 17 8.7 0.5 0 8.7 0.5 59	0.0 0.0 0.0 0.0 2.8 1.5 0.1 0.0 13.1 0.4	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0			
B. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Area Door b. Move On-Ste PM and Transporter to Staging Area c. Unnitch On-Ste PM d. Engage Yoke to MPC/Cask d1. Close Prep Area Door, simultaneously with Step d. e. Place MPC/Cask on Transporter 1. Perform Release HP Survey g. Install Cask Restraints	55 10 10 10 45 46 60	0 10 10 5 10 10 10 0 45 30	1 Operator 1 Prime Mover Operator 1 Increporter Operator 1 Prime Mover Operator 1 Operator 1 Rigman 1 Crane Operator 1 Operator 2 Operators 1 Crane Operator 2 Rodation Protection 2 Operators	0 0 15 15 15 15 10 10 10 10 10 10 10 10 10 10 10 10 10	0 0 0 17 8.7 0.5 0 8.7 0.5 59	0.0 0.0 0.0 0.0 2.8 1.5 0.1 0.0 13.1 0.4 59.0	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0			
B. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Aria Door b. Move Cin-Ste PM and Transporter to Staging Area c. Untitch Cin-Ste PM d. Engage Yoles to MPC/Cask d1. Close Prep Aria Door, simultaneously with Step d. e. Place MPC/Cask on Transporter f. Perform Release HP Survey g. Install Cosk Restraints h. Open Prep Aria Door	5 10 6 10 45 60 60	0 10 10 5 10 10 10 0 45 45 45	1 Operator 1 Piene Mover Operator 1 Increporter Operator 1 Preme Mover Operator 1 Preme Mover Operator 1 Operator 1 Crone Operator 1 Operator 2 Operator 1 Crone Operator 2 Operator 2 Rodiction Protection 2 Operator	0 0 15 15 15 15 10 10 10 10 10 10 10 10 10 10 10 10 10	00 00 177 8.7 0.5 0.5 59 32	0.0 0.0 0.0 0.0 2.8 1.5 0.1 0.0 13.1 0.4 59.0	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0			
8. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Area Door b. Move On-Ste PM and Transporter to Staging Area c. Unhitch On-Ste PM d. Engage Yoke to MPC/Cask d1. Close Prep Area Door, simultaneously with Step d. e. Place MPC/Cask on Transporter f. Perform Release HP Survey g. Install Cask Restations is. Open Prep Area Door L. Prepare Transfer Papers	55 10 65 60 60 60 10	0 10 10 5 10 10 10 0 45 45 45	1 Operator 1 Pitne Mover Operator 1 Itaraporter Operator 1 Pitne Mover Operator 1 Pitne Mover Operator 1 Operator 1 Crane Operator 2 Operator 1 Crane Operator 2 Operators 1 Crane Operator 2 Rodation Protection 2 Operator	00 r 15 15 r 15 r 15 r 15 r 16 r 10	0 0 0 17 8.7 0.5 0 8.7 0.5 59 32	0.0 0.0 0.0 0.0 2.4 1.5 0.1 0.0 0.4 59.0 64.0	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0			
8. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Area Door b. Move On-Site PM and Transporter to Staging Area c. Unfitch On-Site PM d. Engage Yolde to MPC/Cask d1. Close Prep Area Door, simultaneously with Step d. e. Place MPC/Cask on Transporter f. Perform Release HP Survey g. Install Cask Restraints h. Open Prep Area Door L. Prepare Transfer Papers J. Move MPC/Cask Outside Protected Area	55 10 6 10 45 60 60 60 10	0 10 10: 5 10: 10: 10: 0 45: 45: 30: 60: 0	1 Operator 1 Pitne Mover Operator 1 Intraporter Operator 1 Pitne Mover Operator 1 Pitne Mover Operator 1 Operator 1 Crane Operator 2 Operator 2 Operator 2 Rodation Protection 2 Operator 1 Operator 1 Operator	0 0 15 15 15 17 18 18 19 19 19 19 19 19 19 19 19 19 19 19 19	0 0 0 17 8.7 0.5 0 8.7 0.5 59 32 0	0.0 0.0 0.0 0.0 2.4 1.5 0.1 0.0 13.1 0.4 59.0 64.0 0.0	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0			
8. Transfer MPC from Transfer-overpack to Transport-overpack c. Open Prep Area Door b. Move On-Site PM and Transporter to Staging Area c. Untritch On-Site PM d. Engage Yoke to MPC/Cask d1. Close Prep Area Door, simultaneously with Step d. e. Place MPC/Cask on Transporter 1. Perform Release HP Survey g. Install Cask Restraints b. Open Prep Area Door L Prepare Transfer Papers J. Move MPC/Cask Outside Protected Area t. Move MPC/Cask to Transfer Area	55 10 65 10 45 60 60 50	0 10 10 10 10 10 10 45 45 45 30 60 0 10	1 Operator 1 Prime Mover Operator 1 Increporter Operator 1 Prime Mover Operator 1 Operator 1 Operator 1 Crone Operator 2 Operator 2 Operator 2 Radiation Protection 2 Operator 1 Operator	00 r 15 15 r 15 15 r 16 10 10 10 10 10 10 10 10 10 10 10 10 10	0 0 0 17 8.7 0.5 0 8.7 0.5 59 0 0 0.5	0.0 0.0 0.0 0.0 2.8 1.5 0.1 0.0 13.1 0.4 59.0 64.0 0.0 0.0	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0			
8. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Area Door b. Move On-Site PM and Transporter to Staging Area c. Unfitch On-Site PM d. Engage Yoke to MPC/Cask d1. Close Prep Area Door, simultaneously with Step d. e. Place MPC/Cask on Transporter f. Perform Release HP Survey g. Install Cask Restraints h. Open Prep Area Door L. Prepare Transfer Papers J. Move MPC/Cask outside Protected Area	55 10 6 10 45 60 60 60 10	0 10 10 10 10 10 10 0 45 45 45 45 45 45 45 30 60 0	1 Operator 1 Pitme Mover Operator 1 Incraporter Operator 1 Pitme Mover Operator 1 Operator 1 Operator 1 Crone Operator 2 Operators 1 Crone Operator 2 Operators 1 Operator 2 Operators 1 Operator 1 Pitme Mover Operator 2 Operators 1 Pitme Mover Operator	00 r 15 15 r 16 15 r 15 15 15 r 15 15 15 15 15 15 15 15 15 15 15 15 15	0 0 0 17 8.7 0.5 0.5 59 32 0 0 0.5 8.7	0.0 0.0 0.0 0.0 0.0 0.1 1.5 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0			
B. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Area Door b. Move On-Site PM and Transporter to Staging Area c. Untritch On-Site PM d. Engage Yoke to MPC/Cask d1. Close Prep Area Door, structionsoutly with Step d. e. Place MPC/Cask on Transporter f. Perform Release HP Survey g. Install Cask Restraints b. Open Prep Area Door L Prepare Transfer Paper J. Move MPC/Cask Outside Protected Area t. Move MPC/Cask Outside Protected Area	55 10 6 10 45 60 60 60 10	0 10 10 10 5 10 10 0 0 45 45 45 45 30 0 0 10 30 30	1 Operator 1 Prime Mover Operator 1 Increporter Operator 1 Prime Mover Operator 1 Operator 1 Crane Operator 1 Operator 2 Operator 2 Operator 2 Operator 1 Crane Operator 2 Operator 1 Operator 1 Operator 1 Operator 2 Operator 1 Operator 1 Operator 1 Operator 1 Operator 1 Operator 1 Prime Mover Operator 2 Operators 1 Prime Mover Operator 1 Prime Mover Operator	00 15 15 15 15 15 15 15 15 15 15 15 15 15	0 0 0 17 8.7 0.5 0.5 59 32 0 0 0.5 8.7 0.5	0.0 0.0 0.0 0.0 0.0 2.8 1.5 0.1 0.0 13.1 0.4 59.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0			
B. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Area Door b. Move Cin-Ste PM and Transporter to Staging Area c. Untrich Cin-Ste PM d. Engage Yoles to MPC/Cask d1. Close Prep Area Door, struttaneously with Step d. e. Place MPC/Cask on Transporter f. Perform Release HP Survey g. Install Cask Restraints h. Open Prep Area Door L. Prepare Transfer Papers j. Move MPC/Cask Outside Protected Area k. Move MPC/Cask to Transfer Area (rull backgound dose white moving)	55 10 6 10 45 60 60 5 10	0 10 10 10 10 10 10 0 45 45 45 30 0 0 10 30 30 30	1 Operator 1 Piene Mover Operator 1 Preme Mover Operator 1 Preme Mover Operator 1 Preme Mover Operator 1 Operator 1 Operator 2 Operator 2 Operator 2 Roadotton Protection 2 Operator 1 Preme Mover Operator 1 Preme Mover Operator 1 Preme Mover Operator 1 Operator 1 Preme Mover Operator 1 Operator 1 Preme Mover Operator 1 Operator	0 0 15 15 10 10 10 10 10 10 10 10 10 10 10 10 10	0 0 0 17 8.7 0.5 0.5 5 9 0 0.5 8.7 0.5 5 0.5 0.	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 13.1 0.0 64.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0			
B. Transfer MPC from Transfer-everpack to Transport-everpack a. Open Prep Ania Door b. Move Cin-Ste PM and Transporter to Staging Area c. Untritch Cin-Ste PM d. Engage Yoke to MPC/Cask d1. Close Prep Arisa Door, simultaneously with Step d. e. Place MPC/Cask on Transporter f. Perform Release HP Survey g. Install Cask Restaints h. Open Prep Arisa Door L. Prepare Transfer Papers j. Move MPC/Cask Outside Protected Area kt. Move MPC/Cask to Transfer Area (rull backgound diese while moving)	55 10 6 10 45 60 60 60 10	0 10 10 10 10 10 10 0 45 45 45 30 0 0 0 10 30 30 30 30	1 Operator 1 Pitme Mover Operator 1 Intrasporter Operator 1 Pitme Mover Operator 1 Pitme Mover Operator 1 Operator 1 Operator 2 Operator 2 Operator 2 Operator 1 Operator 2 Operator 2 Operator 2 Operator 1 Operator 1 Operator 1 Operator 1 Operator 1 Operator 1 Pitme Mover Operator 1 Pitme Mover Operator 1 Prime Mover Operator 1 Crane Operator 1 Pitme Mover Operator 1 Prime Mover Operator 1 Crane Operator 1 Radiation Protection 2 Operator	00 r 15 15 15 10 10 10 10 10 10 10 10 10 10 10 10 10	00 00 00 177 0.5 00 8.7 0.5 59 00 0.5 8.7 0.5 59 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 13.1 0.4 59.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0			
B. Transfer MPC from Transfer-everpack to Transporf-everpack a. Open Prep Ania Door b. Move Cn-Ste PM and Transporter to Staging Area c. Untitch Cn-Ste PM d. Brigage Yoles to MPC/Cask d1. Close Prep Ariad Door, simultaneously with Step d. e. Place MPC/Cask on Transporter f. Perform Release HP Survey g. Install Cask restrictions h. Open Prep Ariad Door L. Prepare Transfer Papers J. Move MPC/Cask Outside Protected Area (rull backgound close while moving)	55 10 6 10 45 60 60 5 10	0 10 10 10 10 10 10 0 45 45 45 30 60 0 10 10 30 30 30 30 30 40	1 Operator 1 Pitme Mover Operator 1 Incraporter Operator 1 Pitme Mover Operator 1 Operator 1 Operator 1 Operator 2 Operator 2 Operator 2 Radiation Protection 2 Operator 1 Operator 1 Operator 2 Operator 2 Radiation Protection 2 Operator 1 Operator 1 Operator 1 Operator 1 Operator 1 Pitme Mover Operator 1 Pitme Mover Operator 1 Radiation Protection 2 Operators	0 15 15 15 10 10 10 10 10 10 10 10 10 10 10 10 10	00 00 00 177 0.5 8.7 0.5 59 0 0 0.5 8.7 0.5 59 0 0.5 59 0 0.5 59 0 0.5 59 0 0.5 59 0 0 0.5 59 0 0 0.5 59 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.0 0.0 0.0 0.0 0.0 0.0 0.0 13.1 0.4 59.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0			
B. Transfer MPC from Transfer-everpack to Transport-everpack a. Open Prep Area Door b. Move Cin-Site PM and Transporter to Staging Area c. Untrian Cin-Site PM d. Engage Yoles to MPC/Cask d1. Close Prep Area Door, simultaneously with Step d. e. Place MPC/Cask on Transporter f. Perform Release HP Survey g. Install Cask Restraints h. Open Prep Area Door L. Prepare Transfer Papers j. Move MPC/Cask Outside Protected Area k. Move MPC/Cask to Transfer Area (rull backgound dose white moving)	55 10 6 10 45 60 60 5 10	0 10 10 10 10 10 10 0 45 45 45 45 45 45 45 45 45 45 45 45 45	1 Operator 1 Pitme Mover Operator 1 Incraporter Operator 1 Pitme Mover Operator 1 Operator 1 Operator 1 Operator 2 Operator 2 Operator 2 Operator 2 Operator 1 Operator 2 Operator 1 Operator 2 Operator 1 Pitme Mover Operator 1 Crane Operator 1 Crane Operator 1 Pitme Mover Operator 1 Crane Operator 1 Rediction Protection 2 Operators 1 Pitme Mover Operator 1 Rediction Protection 2 Operators 1 Pitme Mover Operator 1 Pitme Mover Operator	0 15 15 15 16 10 10 10 10 10 10 10 10 10 10 10 10 10	00 00 00 177 0.55 90 00 0.55 8.77 0.55 8.77 0.55 0.55 0.55 0.55	0.0 0.0 0.0 0.0 0.0 0.0 0.0 13.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0			
B. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Aria Door b. Move Cin-Ste PM and Transporter to Staging Area c. Untrich Cin-Ste PM d. Engage Yote to MPC/Cask d1. Close Prep Aria Door, simultaneously with Step d. e. Place MPC/Cask on Transporter f. Perform Release HP Survey g. Install Cask Restraints h. Open Prep Aria Door L. Prepare Transfer Papers j. Move MPC/Cask Outside Protected Area k. Move MPC/Cask to Transfer Area (rull backgound dose while moving) i. Prepare Cask for MPC Transfer (assume decon area background dose)	55 10 6 10 45 60 60 5 10 10 60	0 10 10 10 10 10 0 0 45 45 45 45 30 0 0 10 30 30 30 30 30 60 60 60	1 Operator 1 Pitme Mover Operator 1 Incraporter Operator 1 Pitme Mover Operator 1 Operator 1 Operator 1 Operator 2 Operators 1 Operator 2 Operators 1 Operator 2 Radiation Protection 2 Operator 1 Pitme Mover Operator 2 Operators 1 Pitme Mover Operator 1 Crane Operator 1 Prime Mover Operator	0 15 15 15 10 10 10 10 10 10 10 10 10 10 10 10 10	00 00 00 00 17 8.7 0.5 90 00 0.5 8.7 0.5 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.00 0.00 0.00 0.00 0.00 0.00 13.1 0.44 59.00 0.00 0.1 8.7 70.00 0.5 11.0	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0			
B. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Area Door b. Move Cin-Ste PM and Transporter to Staging Area c. Untritch Cin-Ste PM d. Engage Yake to MPC/Cask d1. Close Prep Area Door, simultaneously with Step d. e. Place MPC/Cask on Transporter f. Perform Release HP Survey g. Install Cask Restaurations in Open Prep Area Door L. Prepare Transfer Papers j. Move MPC/Cask Outside Protected Area k. Move MPC/Cask to Transfer Area (rull backgound dose while moving)	55 10 6 10 45 60 60 5 10	0 10 10 10 10 10 0 0 45 45 45 30 0 0 10 30 30 30 60 60 60 60	1 Operator 1 Pitme Mover Operator 1 Itaraporter Operator 1 Pitme Mover Operator 1 Pitme Mover Operator 1 Operator 1 Operator 1 Operator 2 Operators 1 Crane Operator 2 Radiation Protection 2 Operators 1 Operator 1 Operator 1 Operator 1 Operator 1 Pitme Mover Operator 1 Pitme Mover Operator 1 Itarae Operator 1 Pitme Mover Operator 1 Operator 1 Operator 1 Itarae Operator 1 Operator 1 Crane Operator 1 Radiation Protection 1 Operator	0 15 15 15 10 10 10 10 10 10 10 10 10 10 10 10 10	0 0 0 0 0 177 8.7 0.5 9 9 0 0 0 0 0 0 0 0 8.7 5 9 9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.00 0.00 0.00 0.00 0.00 0.00 1.5.1 0.4.0 64.0 0.0 0.1 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0			
B. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Aria Door b. Move Cin-Ste PM and Transporter to Staging Area c. Untrich Cin-Ste PM d. Engage Yote to MPC/Cask d1. Close Prep Aria Door, simultaneously with Step d. e. Place MPC/Cask on Transporter f. Perform Release HP Survey g. Install Cask Restraints h. Open Prep Aria Door L. Prepare Transfer Papers j. Move MPC/Cask Outside Protected Area k. Move MPC/Cask to Transfer Area (rull backgound dose while moving) i. Prepare Cask for MPC Transfer (assume decon area background dose)	55 10 6 10 45 60 60 5 10 10 60	0 10 10 10 10 10 0 45 45 45 30 0 0 0 0 0 30 30 30 30 30 60 60 60 60 60 60 60 60 60 60 60 60 60	1 Operator 1 Pitme Mover Operator 1 Itanaporter Operator 1 Pitme Mover Operator 1 Pitme Mover Operator 1 Operator 1 Operator 1 Operator 2 Operator 2 Operator 1 Pitme Mover Operator 2 Operator 1 Pitme Mover Operator 1 Pitme Mover Operator 1 Pitme Mover Operator 1 Radiation Protection 2 Operator 1 Radiation Protection 1 Radiation Protection 1 Pitme Mover Operator 1 Radiation Protection 1 Operator 1 Radiation Protection 1 Operator	0 15 15 15 10 10 10 10 10 10 10 10 10 10 10 10 10	0 0 0 0 0 177 8.7 0.5 9 32 0 0 0.5 8.7 70 0.5 9 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7	0.00 0.00 0.00 0.00 0.00 0.00 13.1 0.4 64.0 0.0 0.1 8.7 0.3 4.4 70.0 0.5 0.5 11.0	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0			
B. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Area Door b. Move Chr-Ste PM and Transporter to Staging Area c. Untrich Chr-Ste PM d. Brigage Yoke to MPC/Cask d1. Close Prep Area Door, structraneously with Step d. e. Place MPC/Cask on Transporter 1. Perform Release HP Survey g. Install Cask Restraints h. Open Prep Area Door L. Prepare Transfer Papers j. Move MPC/Cask to Transfer Area (rull backgound dose white moving) L. Prepare Cask for MPC Transfer (assume decon area background dose) m. Engage Cranse to MPC Lift Attachment	55 10 60 60 55 10 60 60	0 10 10 10 10 45 45 45 45 45 45 45 45 45 45 45 45 45	1 Operator 1 Pitme Mover Operator 1 Itanaporter Operator 1 Pitme Mover Operator 1 Pitme Mover Operator 1 Operator 1 Operator 1 Operator 2 Operator 2 Operator 2 Operator 2 Operator 1 Operator 1 Operator 1 Operator 2 Operator 1 Pitme Mover Operator 1 Radiation Protection 2 Operator 1 Radiation Protection 2 Operator 1 Radiation Protection 1 Operator	0 15 15 15 10 10 10 10 10 10 10 10 10 10 10 10 10	0 0 0 0 17 0.5 8.7 0.5 9 0 0 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.0 0.0 0.0 0.0 0.0 0.0 0.0 13.1 0.4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0			
B. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Area Door b. Move Ch-Site PM and Transporter to Staging Area c. Untrich Ch-Site PM d. Brigage Yoke to MPC/Cask d1. Close Prep Area Door, simultaneously with Step d. e. Place MPC/Cask on Transporter f. Perform Release HP Survey g. Install Cask Restraints h. Open Prep Area Door i. Prepare Transfer Papers j. Move MPC/Cask Outside Protected Area k. Move MPC/Cask to Transfer Area (mill backgound dose white moving) i. Prepare Cask for MPC Transfer (assume decon area background dose) m. Engage Crane to MPC Lift Affectment	55 10 6 10 45 60 5 10 10 60	0 10 10 10 10 0 45 45 45 45 45 45 45 45 45 45 45 45 45	1 Operator 1 Pitme Mover Operator 1 Incraporter Operator 1 Pitme Mover Operator 1 Operator 1 Operator 1 Operator 2 Operator 2 Operator 2 Operator 2 Operator 1 Operator 2 Operator 1 Operator 1 Operator 2 Operator 1 Pitme Mover Operator 1 Crane Operator 1 Radiation Protection 2 Operator 1 Pitme Mover Operator 1 Radiation Protection 1 Operator 1 Operator 1 Operator 1 Operator 1 Operator	0 15 15 15 10 10 10 10 10 10 10 10 10 10 10 10 10	0 0 0 0 17, 8.7 0.5 8.7 0.5 9, 0.5 9, 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.00 0.00 0.00 0.00 0.00 0.00 13.1 0.00 0.01 0.00 0.01 0.00 0.00	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0			
B. Transfer MPC from Transfer-everpack to Transport-everpack a. Open Prep Area Door b. Move Cin-Site PM and Transporter to Staging Area c. Untrich Cin-Site PM d. Engage Yotes to MPC/Cask d1. Close Prep Area Door, simultaneously with Step d. e. Place MPC/Cask on Transporter 1. Perform Release HP Survey g. Install Cask Restraints h. Open Prep Area Door L. Prepare Transfer Papers J. Move MPC/Cask Outside Protected Area tr. Move MPC/Cask to Transfer Area (multipack Cask for MPC Transfer (casume decon area background dose) m. Engage Crane to MPC Lift Attachment a. Verity Vertical Alignment of MPC to Storage Cask o. Clear Operations to a Strielded Area	55 10 60 60 55 10 60 60	0 10 10 10 10 0 45 45 45 45 45 45 45 45 45 45 45 45 45	1 Operator 1 Pitme Mover Operator 1 Itanaporter Operator 1 Pitme Mover Operator 1 Pitme Mover Operator 1 Operator 1 Operator 1 Operator 2 Operator 2 Operator 2 Operator 2 Operator 1 Operator 1 Operator 1 Operator 2 Operator 1 Pitme Mover Operator 1 Radiation Protection 2 Operator 1 Radiation Protection 2 Operator 1 Radiation Protection 1 Operator	0 15 15 10 10 10 10 10 10 10 10 10 10 10 10 10	0 0 0 0 17, 8.7 0.5 8.7 0.5 9, 0.5 9, 0.5 11, 39,4 111 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.00 0.00 0.00 0.00 0.00 0.00 13.1 0.44 59.00 0.00 0.1 13.0 0.00 0.00 0.00 0.00 0.	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0			
B. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Area Door b. Move On-Site PM and Transporter to Staging Area c. Unfitch On-Site PM and Transporter to Staging Area c. Unfitch On-Site PM d. Engage Yoke to MPC/Cask d1. Close Prep Area Door, struttaneously with Step d. e. Place MPC/Cask on Transporter f. Perform Release HP Survey g. Install Cask Restraints h. Open Prep Area Door L. Prepare Transfer Papers J. Move MPC/Cask to Transfer Area (rull backgound dose while moving) ii. Prepare Cask for MPC Transfer (assume decon area background dose) m. Engage Crane to MPC Lift Attachment n. Verity Vertical Alignment of MPC to Storage Cask o. Clear Operators to a Shelded Area ol. Close Transfer Room Doors	55 10 6 10 45 60 5 10 10 60	0 10 10 10 10 10 0 0 45 45 45 30 0 0 10 30 30 30 60 60 60 60 60 60 60 60 60 60 60 60 60	1 Operator 1 Pitme Mover Operator 1 Incraporter Operator 1 Pitme Mover Operator 1 Operator 1 Operator 1 Operator 2 Operators 1 Operator 2 Operators 1 Operator 2 Operators 1 Operator 1 Operator 2 Operators 1 Operator 1 Operator 1 Operator 1 Operator 1 Operator 1 Operator 1 Pitme Mover Operator 2 Operators 1 Pitme Mover Operator 1 Crane Operator 1 Radiation Protection 2 Operators 1 Pitme Mover Operator 1 Radiation Protection 1 Operator 1 Operator 1 Operator	0 15 15 15 10 10 10 10 10 10 10 10 10 10 10 10 10	0 0 0 0 17 0.5 59 0 0 0.5 8.7 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 0.5 8.7 70 9.5 8.7 70 9.5 8.7 70 9.5 8.7 8.7 9.5 9.5 9.5 9.5 9.5 9.5 9.5 9.5 9.5 9.5	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0			
B. Transfer MPC from Transfer-overpack to Transport-overpack a. Open Prep Area Door b. Move On-Site PM and Transporter to Staging Area c. Untritch On-Site PM d. Engage Yoke to MPC/Cask d1. Close Prep Area Door, structionsously with Step d. e. Place MPC/Cask on Transporter 1. Perform Release HP Survey g. Install Cask Restraints b. Open Prep Area Door L. Prepare Transfer Papers J. Move MPC/Cask of Transfer Area (rull backgound dose white moving) i. Prepare Cask for MPC Transfer Area (rull backgound dose white moving) ii. Prepare Cask for MPC Transfer (assume decon area background dose) m. Engage Crans to MPC Lift Attachment n. Verity Vertical Alignment of MPC to Storage Cask o. Clear Operators to a Strietded Area o1. Close Transfer Room Doors p. Roise MPC from Storage Cask	55 10 6 10 60 60 60 10 60 60 60 10 10	0 10 10 10 10 0 45 45 45 30 0 0 0 10 30 30 30 30 60 60 60 60 60 60 60 60 60 60 60 60 60	1 Operator 1 Pitme Mover Operator 1 Intrasporter Operator 1 Pitme Mover Operator 1 Pitme Mover Operator 1 Operator 1 Operator 1 Operator 2 Operators 1 Operator 2 Rodiction Protection 2 Operators 1 Operator 1 Operator 2 Operators 1 Operator 2 Operators 1 Operator 1 Operator 1 Operator 1 Operator 1 Pitme Mover Operator 1 Pitme Mover Operator 1 Prime Mover Operator 1 Crane Operator 1 Radiction Protection 2 Operators 1 Pitme Mover Operator 1 Crane Operator 1 Radiction Protection 1 Radiction Protection 1 Radiction Protection 1 Radiction Protection 1 Operator 1 Radiction Protection 1 Operator 1 Rodiction Protection 1 Operator 1 Operator 1 Operator 1 Operator	0 15 15 15 10 10 10 10 10 10 10 10 10 10 10 10 10	0 0 0 0 17 8.7 0.5 8.7 0.5 9.0 0.5 8.7 0.5 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.00 0.00 0.00 0.00 0.00 0.00 0.00 13.1 0.4 64.0 0.00 0.1 13.7 0.3 13.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0			
8. Transfer MPC from Transfer-overpack to Transport-overpack c. Open Prep Area Door b. Move On-Site PM and Transporter to Staging Area c. Untitch On-Site PM and Transporter to Staging Area c. Untitch On-Site PM d. Engage Yoke to MPC/Cask d1. Close Prep Area Door, strustaneously with Step d. e. Place MPC/Cask on Transporter 1. Perform Release HP Survey g. Install Cask Restraints h. Open Prep Area Door L. Prepare Transfer Ropers J. Move MPC/Cask to Transfer Area (rull backgound dose while moving) ii. Prepare Cask for MPC Transfer (casume decon area background dose) m. Engage Crans to MPC Util Attachment n. Verity Vertical Alignment of MPC to Storage Cask o. Clear Operators to a Strelded Area ol. Close Transfer Room Doors	55 10 66 10 45 60 50 10 60 60 10 10	0 10 10 10 10 0 10 10 10 10 10 10 10 10	1 Operator 1 Pitme Mover Operator 1 Itanaporter Operator 1 Pitme Mover Operator 1 Pitme Mover Operator 1 Operator 1 Operator 1 Operator 2 Operator 2 Operator 1 Operator 1 Operator 1 Operator 2 Operators 1 Operator 1 Pitme Mover Operator 1 Pitme Mover Operator 1 Radiation Protection 2 Operators 1 Radiation Protection 1 Radiation Protection 1 Radiation Protection 1 Operator 1 Radiation Protection 1 Operator 1 Crane Operator 1 Radiation Protection 1 Operator	15 15 15 16 16 16 16 16 16 16 16 16 16 16 16 16	0 0 0 0 17 8.7 0.5 8.7 0.5 9 0.5 8.7 0.5 11 11 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.0 0.0 0.0 0.0 0.0 0.0 0.1 13.1 0.4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0			

Table A1-4. Utilities-MPC (continued)

t. Lower MPC Into Transport Coak	30		Remote	0	0	0.0	0.0			
f), Open Transfer Room Doors			Remote	0	0	0.0				
se Bardation and Contamination Survey	10		Radiction Protection	2	2	14.3				
v. Remove MPC Lift Attachment from MPC	30		Operators	2	97	64.7	0.7	 		
<u> </u>			Rogman	10	8.7	22	0.3		-+	
		15 1	Crane Operator	20	0.5	0.1	0.3			
w. Disengage Craris from MPC Lift Affactment	10	5; 1	Operator	2	39.4	3.3	0.1			
W. COST C.C. C.C.		10: 1	Ragman	10	8.7	1.5	0.2			
		10: 1	Crane Operator	20	0.5	0.1	0.2			
	10	10	Operator	2	97	16.2	0.2			
x. Place Transport Calk Ud			Ragman	10	8.7	1.5	0.2			
			Crane Operator	20	0.5	0.1	0.2			
	30		Operators	2	59	59.0	1.0			
y. Decon Cask	- 30			20	0.5	03	0.5		-+	
			Crane Operator		59	39.3	0.7			
2. Perform HP Survey	45		Rediation Projection	2				┝╼┯┼╌		
cac. Secure Overpack Cask Balted Ltd	60		Operators	2	59	118.0	20			
Total	510	496				578.2	12.8	—- <u>+</u>		
		i						—— <u>i</u>		
9. Prop MPC/Transpodation-								<u> </u>		
overpock from Pool Prep for shipping	1		casarume cacaute case a po	dorou	nd do					
Oran Charles And Code	5	0	Operator	0	0		0.0			
Open Stoping Area Door Move On-Site PM and Off-Site Transporter to Stoping Area	30		Prime Mover Operator	15	0.5	0.1	0.0	L		
D. WOAD OLIVIES LING TO CHARGE RESIDENCE IN CHARGE OF MA	5		Prime Mover Operator	15	0.5	0.0	0.0			
c. Unhitch Ch-Site PM	10		Operator	2	17	28	0.0			
d. Engage Yolke to MPC/Coak	'4		Ragman	10	8.7	1.5	0.0			
			Crone Operator	20	0.5	6.1	0.0		-	
	 		Operator	- 20		0.0	0.0		$\overline{}$	
d1. Glose Staging Area Door, simultaneously with Step d.	45			10	1.6	2.7	0.4		-	
e. Place MPC/Cask on Transporter	-		Operators	20	0.5	0.4	0.2	 		
	┝╾╤╉		Crane Operator			50.2	0.3	 -		
£ Perform Shipping HP Survey	80		Radiation Protection	2	43			├──┼	+	
g. Install Cask Restraints	35		Operators	2	32	37.3	0.3	 -		
			Crane Operator	20	0.5	0.3	0.2	├	 +	
h. install impact Limites	55	35	Operators	2	32	58.7	0.5		 +	
IZ EBIOR ETEXAC: CHINALD		55	Crane Operator	20	0.5	0.5	0.2	!		
to the Democracy Border	70	701	Operators	2	K	74.7	0.6	i		
L. Install Personnel Barler			Crane Operator	20	0.5	0.3	0.3		\perp	
	10		Operator	0	0	0.0	0.0	:		
J. Prepare Shipping Papers	5		Operator	0	ō	0.0	0.0	-		
k. Open Prep Area Door	5		Prime Mover Operator	15	0.5	0.0	9		$\neg \neg \neg$	
1. Hitch On-Sile PM				15	0.5	0.3	0.1		-	
m. Move Cask/MPC to Protected Area	30		Prime Mover Operator	2	17	2.4	0.0			
n. Perform security check	5		2 Security Officers	15		0.0	0.0			
n. Untritch On-Site PM	5		Prime Mover Operator		0.5		0.5	 		
n1. Malas-up with other cask cas per train (assume 3 cas)	60		2 Operator-rail	15	1.2	24		 	+	
a. Hitch Ott-Site PM	5		Prime Mover Operator	15	0.5	0.0		┝╌╬	+	
iolai	440	6451	<u> </u>			235.6	3.6			-
							L	ļ .		
10. Prep MPC/Transfer-overpack from Pool Prep for SPSI			casume crone enclosus	bock	gain	d dose		<u> </u>	\rightarrow	
a. Open Staging Area Door	5	01	1 Operator	0	0	0.0				
The second secon	10	10'	1 Prime Mover Operator	15	0	Q	0.0			
b. Move On-Site PM and Iransporter to stock to Area		101	1 Transporter Operator	15	٥	0.0	0.0	1		
	5	5;	1 Prime Mover Operator	15	0	0.0	0.0		1	
c. Untitch On-Ste PM	10		1 Operator	2		6.2	0.0	I		
d. Engage Yoke to MPC/Cark	 		1 Rooman	10		1.5			T	
	 	10	1 Crane Operator	20						
	 	0	1 Operator	0					$\overline{}$	
dl. Close Stoging Area Door, smultaneously with Step d.	+		2 Operators	10						
e. Place MPC/Calk on Transporter	45	45	1 Crane Operator	20						
	1			2					+	
f. Perform Release HP Survey	60		2 Radiation Protection							
g. Install Cosk Redicints	60		2 Operators	2						
h. Open Prep Area Door	5		1 Operator	0						
L. Prepare Transfer Papers	10		1 Operator	0					\longrightarrow	
J. Move MPC/Calk Outside Protected Area	10		1 Prime Mover Operator						+	
k Move MPC/Cosk to ISFSI	60		2 Operators	10						
(casume null background dose while moving)		301	1 Prime Mover Operator					 		
		30	1 Crane Operator	20						
	1	30	1 Radiation Protection	10	8.7	44				
Total	280	365				157.8	1.4	_		
I Table	1	· ·	1	1				í		
11. Transfer Loaded MPC from Transfer-	1	1	T			I				
11. House, found M. C hour trainies.	1	1	assume SFSI backgrou	nd dow	,	x time	s align	ed with	UTS-RDS	5 step
I	+	30	2 Operators	2						
overpack to ISFSI (like step 12, following)	. ~		1 Prime Mover Operator							
overpack to ISFSI (the step 12, following) a. Prepare Cask for MPC Transfer	60	I An:								
everpock to ISPSI (like step 12, following) a. Prepare Cask for MPC Transfer	-	60:	1 Crosse Country							
everpack to ISPSI (Bite step 12, following) a. Prepare Cask for MPC Transfer	- ~	60	1 Crone Operator	20						
a. Prepare Cask for MPC Transfer		60: 60:	1 Raciation Protection	10	8.7	8.7	2.0	+	+	
Prepare Cask for MPC Transfer al. Casa SFS Sorage Door, simultaneously	- ~	60	Raciation Protection Operator	10	8.7 70	8.7 23.3	2.0 0.7			
Prepare Cask for MPC Transfer al. Casa SFS Sorage Door, simultaneously		60 60 20	Radiation Protection Operator Prime Mover Operator	10 2 15	8.7 70 8.5	8.7 23.3 0.0	2.0 0.7 0.0			
Prepare Cask for MPC Transfer		60 60 20 0	Raciation Protection Operator Prime Mover Operator Crane Operator	10 2 15 20	8.7 70 0.5 0.5	8.7 23.3 0.0 0.0	0.7 0.0 0.0			
Repare Cask for MPC Transfer Cosa SFS Storage Door, simultaneously		60 60 20	Radiation Protection Operator Prime Mover Operator	10 2 15	8.7 70 0.5 0.5 8.7	8.7 23.3 0.0 0.0 0.0	2.0 0.7 0.0 0.0			

Table A1-4. Utilities-MPC (continued)

									,		-
		60	1	Prime Mover Operator	15	3	0.5				<u> </u>
		60	1	Crane Operator	20	3	0.5				1
		60		Radiation Protection	10	8.7				:	
Control Constant	60	30	2	Operators	2	70	70.0	20		1	<u>L</u>
Prepare Stansfer Equipment		60		Prime Mover Operator	15	0.5	0.5	20			$\Gamma_{}$
		60		Crane Operator	20		0.5	2.0			
		60		Radiation Protection	10	8.7	8.7	20	1	:	1
					10		8.7			. 	
1 Transfer MPC From Cosk to ISFSI	30	30		Operators	15		0.3				╅╾
		30		Prime Mover Operator							┼
		30		Crane Operator	B	0.5	0.3			}	┼—
		30	1	Radiation Protection	10		4.4	1.0			↓
. Close SFS Storage Door	30	30	1	Operator	2	70	35.0			<u> </u>	-
		30	1	Pitrie Mover Operator	15	0.5	03	10	<u> </u>	!	1
		30		Crane Operator	20	0.5	0.3	2			Ι
		30		Raciation Protection	10	8.7	44	1.0			T
		- 37/		ROCCOCCION.			0.0				
. Prepare for Transportation of MPC On-Site Transfer Calk					2	36	35.0	20		-	_
from ISF8i	- 60	30	2	Operators				20		 	-
		60		Prime Mover Operator	15		0.5			ļ	├ ─
		8		Crane Operator	20	0.5	0.5	20		<u>!</u>	-
		60	1	Radiation Protection	10	8.7	8.7	20		<u> </u>	<u> </u>
	300	1100					299.2	41.7			<u> </u>
otal	- 333										1
A Company of the Comp		 							Г	}	
Transfer MPC fexm/to Transportation-overpack	——	 		casume ISFSI backgrour	vi da	x three	n da	ed will	h UIS	ROS stec	13 v
n ISFSI (Tike Step 11), of UTS-RDS apreadsheet)					2	0		20		!	1
Prepare Cask for MPC Transfer	- 60			Operators							1
	لسبا	- 60		Prime Mover Operator	15					!	+-
	لــــا	8		Crane Operator	20	0				<u> </u>	┼
		60		Radiation Protection	10					<u> </u>	₩-
b. Align Calk with ISSI	8	30	2	Operators	2	0					-
A CONTRACTOR MINISTER		- 60		Prime Mover Operator	15	٥	0.0	20			<u></u>
		40		Crane Operator	20	0	0.0	20			
		- 60		Radiation Protection	10	0	0.0	2.0			
					2	60	20.0				1
c. Open ISFSI Storoge Door	0	20		Operators	15	0.5	0.0			:	 -
multicreous with ship a		0		Prime Mover Operator				0.0			
only one crane, PM operator and HP in crew)		0		Crane Operator	20	0.5	0.0				
		0	0	Radiation Protection	10		0.0			<u> </u>	↓
d. Prepare Transfer Equipment	60	30	2	Operators	2	60	60.0				
G Mahria Ma sa Catalina	-	60	1	Prime Mover Operator	15	0.5	0.5	20		1	
		-60		Crone Operator	20	0.5	0.5	20			
		60		Radiation Protection	10	8.7	8.7	2.0		-	Т
	30			Operators	10			20		:	
e. Transfer MPC to Off-Site Transportation Casic	بع			Prime Mover Operator	15					:	1
	-	30			20						+-
		30		Crane Operator						 	
		30		Radiation Protection	10						
t. Close ISFSI Storcyje Door	30	30		Operators	2						┼
		30	1	Prime Mover Operator	15					<u> </u>	ــــ
	1	30	1	Crane Operator	8	0.5	0.3	1.0	٠	t	<u> </u>
		30		Radiation Protection	10	8.7	44	1.0	1	i	
	55	ستجرب ف		Operators	2	60	110.0	3.7		;	П
g. Install Cosk Closure				Prime Mover Operator	15	_	0.5				Т
	ļ	_ 55			20		_			. 	1
		_ 55		Crane Operator						ı	+
	<u> </u>	55	1	Radiotion Protection	19	8.7	8.0		1		┼
h. Prepare to Move Off-Site Transportation Coals From ISFS						<u> </u>	0.0				₩
	60	30	2	Operators	2						
Slorage Yard	T	60	1	Partie Mover Operator	15	0.5	0.5				_
	1	60	1	Crane Operator	20	0.5	0.5	20			
	1	- 80	; 	Radiation Protection	10		_	20			\Box
	400	1320				T		51,3			Π
Total	 	1		 			T			1	Π"
		ł			 	 		 		. 	1
 Peop MPC/Transportation-overpack from ISFSI for Ship 	pino	 						سند لام	1		1
(derived from Steps of Sb. rail, of UTS-RDS spreadtheet)		ļ		casume SFSI backgrou	10 00	- 	57.3	2.7	7	. 	1
a. Perform Release HP Survey(s -diameter)	80			Radiation Protection	2	_				,	+-
b. Install Cask Restrants(s-perimeter)	35			Operators	2	_					+
		35		Crane Operator	20						+
	55	55		Operators	2						₩
e betef trecest (imitee(s-dismeter)		55		Crane Operator	20	0.5	0.5				↓_
c. Install Impact Limiten(s-diameter)	1			Operators	2		747	4.7	1		
	700				20						Γ
	70	70		Conna Coerció							Т
d. Install Personnel Barrier(s-perimeter)		70 35		Crone Operator			0.0	l on	P 1		
d. Install Personnel Barrier(s-perimeter) e. Prepare Shipping Papers	10	35 0		Operator	0	0					1
d. Install Personnel Barrier(s-perimeter) a. Prepare Shipping Papers	10	35 0 0		Operator Operator	0	0	0.0	0.0		1	
d. Install Personnel Barrier(s-perimeter) e. Prepare Shipping Papers C. Open Prep Area Door O. Hitch On-She Prime Mover	10 5	35 0 0 5		Operator Operator Prime Mover Operator	0 0 15	0.5	0.0	0.2	2		
c. Install Impact Limitents-diameter) d. Install Personnel Barrier(s-perimeter) e. Prepare Shipping Papers f. Open Prep Area Boor g. Hitch On-She Prime Mover f. Move Coals to Protected Area Gote (null background de	10 5 5 30	70 35 0 0 5 5 5 30		Operator Operator Prime Mover Operator Prime Mover Operator	0 0 15 15	0.5 0.5	0.0	0.2			
d. Install Personnel Barrier(s-perimeter) e. Prepare Shipping Papers f. Open Prep Area Coor g. Hitch On-She Prime Mover h. Move Cook to Protected Area Gate (null background do	10 5 5 30	70 35 0 0 0 5 5 5 5 5 5		Operator Operator Prime Mover Operator Prime Mover Operator Security Officers	0 0 15 15	0.5 0.5 0.5	0.0 0.0 0.3	0.0 0.2 1.0			
d. Install Personnel Barrier(s-perimeter) e. Prepare Shipping Papers f. Open Prep Area (boar g. Hitch On-She Prime Mover h. Move Cosk to Protected Area Gote (null background do l. Perform security check	10 5 5 30	70 35 0 0 0 5 5 5 5 5 5		Operator Operator Prime Mover Operator Prime Mover Operator	0 0 15 15 2 15	0.5 0.5 0.5 17 0.5	0.0 0.0 0.3 3.4 0.0	0.0 0.2 1.0 0.0			
d. Install Personnel Barrier (s-perimeter) e. Prepare Shipping Papers f. Open Prep Area (boar g. Hitch On-Site Prime Mover h. Move Cask to Protected Area Gate (null background do i. Endorm security check i. Un-hitch On-Site Prime Mover	10 5 5 30	70 35 0 0 5 5 30 30 5 5 5 5		Operator Operator Prime Mover Operator Prime Mover Operator Security Officers	0 0 15 15 2 15	0.5 0.5 17 0.5	0.0 0.3 3.4 0.0 2.4	0.0 0.2 1.0 0.0 0.0			
d. Install Personnel Barrier(s-perimeter) e. Prepare Shipping Papers f. Open Prep Area (boar g. Hitch On-She Prime Mover h. Move Cosk to Protected Area Gote (null background do l. Perform security check	10 5 5 30 8	70 35 0 0 0 5 5 5 5 5 5 5		Operator Operator Prime Mover Operator Prime Mover Operator Security Officers Prime Mover Operator	0 0 15 15 2 15	0.5 0.5 17 0.5	0.0 0.3 3.4 0.0 2.4	0.0 0.2 1.0 0.0 0.0			

Table A1-5 through A1-8. Monitored Retrievable Storage (MRS) Facility

Table A1-5. MRS-Reference

tal Doses per Cask Handling for SP3 of the MRS		:		Truck & Ros mem/hr		errern.	yound Vitr	
vised 20 May 94/HWG	(Cirect			lid doses		0.00		\vdash
	ntperson-			indi		06		
load Truck Cosk:Steps-(1a,3,5) for SPS, TSC, MPU, MPC	507	111		CURRENT COMPANY REAL		deco		
Load Boil Cody-Stepty-(1b.3.5); only \$75 technology	- 651	12	-004	îp/îx cakild		20	3	<u> </u>
Unload rall is also used at the MGDS.				Lateral Sidn			1 2	
gd Storage Cask				Storage cask mrem/hr	-	5.0	┼──╸	
Steps - (2.3.4)	863	13	867	Ud dones	220		1 0	-
344 444				rner	_			-
- All Cont	7			outer	97		 	├ ──
Noad Storage Cask	1,063	11	1,094	Tp/Tx conkild	9		↓	
Steps - (3,7)				Lateral San	70		↓	↓
					ì		↓	↓
ad Roll Cosk & Ship	443	8	451		:	<u> </u>	1	
Steps - (2.3.6)					Τ.		I	
	32.0		32		$\overline{}$			Γ
all Flow-Twough (Step 8)					\vdash			
of flow through is the same for all technologies.					1		T	
							1	1
	An)		Personnel Becufred(Persons /Toak)		section)	(Museul)	(Dearst (Can)	
Cask Handling Opersitors	fold Tak Time(Min.)	Dose fime(Min.)	Personnel Becarity	5	Wedding Distances (Feet)	Code Does But setting	Chemical Parket Band	
			┼		Ţ		1	
a. Receive and Prep Loaded Truck Cask (all	_ 		┼─	casume ruit dose initio	₹-	 		_
Irrost podation Cask list Unloading		.] -	Operator		3 7	0.0	0.0
a. Inspect Bills of Lacing, Other Shipping Papers	10			Prime Mover Operato				_
b. Pull Cosk into Security Area				Security Officers				3 0.0
a Committy Instruction	, X					_		
d. Perform HP Survey of Coak Externals and Trailer	30			Radiation Protection				_
e. Take Cask to Protected Area	10			Prime Mover Operato				
1. Unhtich Off-She Prime Mover	, 10	10		Prime Mover Operato		_		
p. Hich Site Prime Mover	; 10	10		Prime Mover Operato		_		_
h. Take Cask to Recuilling and Shipping Bay Door	30	0 10	0	1 Prime Mover Operato				
h. Open Receiving and Shipping Bay Door, smulfaneous				1 Operator			0 0.0	
ht. Open Received (3 to 3 to 4 to 5		5 (5	1 Prime Mover Operato	x 1			
L Take Cask into Receiving and Shipping Bay				1 Rooman	1(0 8		
	10			1 Prime Mover Operak	or 1	5 0	5 0.0	8 0
J. Untritch Site Prime Mover				1 Operator		0	0.0	0 0
11. Close Receiving and Shipping Bay Door, smultaneous	72			2 Operators	· ;	3 3	2 26.6	7 0
k. Remove Personnel Borrier		2	_	1 Crons Operator	. 2	0 0	5 0.2	1 0
(crane area bookground done)				2 Radiation Protection			3 143	3 0
I HP SUNW	2						2 640	0 0
m. Remove impact Limiters		0 6		2 Operators			5 0.5	
			<u> </u>	1 Crone Operator				3 0
n. Remove flectowns	3			2 Operators				20 0
		سبينسيون.	5	1 Crane Operator	_		12 10.6	_
o. Remove Trunnion Blocks			<u> </u>	2 Operators				3 0
			<u> </u>	1 Crane Operator				o o
o1. Open SNF transport Cask Prep Room Door, simultaned	X8 !		<u> </u>	1 Operator		일		80 8
p. Affoch Crone to Voke	1		5	1 Operator				80 0
D. 7.1.00.	1		5	1 Rooman		9		00 0
			5	1 Crone Operator		<u> </u>		20 6
g. Engage Voke to Cosk		5	5	1 Operator	 -			73 6
4 0444 1000 1000	•	1	5	1 Ragman				
		1	5	1 Crane Operator		<u> 20 0</u>		04 0
r. Move Cask Into SNF Transport Cask Prep Room			\Box			- 1	_	
	:	10	10	2 Operators				
Workdown Arec			10	1 Crane Operator			_	08 (
		10	10	1 Operator				45 (
s. Install Picifican			35	2 Operator				83 (
1. Washdown Cask			15	2 Radiation Protection	1	2		50 (
u HP SUVY			10	1 Operator		6 8		45
			10	2 Operators	i			.60
v Pernove Platform		. 41		1 Crane Operator		20 (0.5 0	.08
			101					
v. Remove Platform w. Move Transport Cask to Carrier			10			10		
v Remove Platform		20	20	2 Operators	_			.17
v. Remove Platform w. Move Transport Cask to Carrier		20			_	20 (0.5 0	

Table A1-5. MRS-Reference (continued)

	10	1	Flogman	10	8.7	1.45	
	10	<u> </u>	Crane Operator	20	0.5	0.06	0.04
z trutal Grield Platform 30	30		Operator	6	8.7	4.35	0.13
act. Attach lid covity Gas Sampling/Venting Rig 10			Operator	2	- 60	10.00	0.04
			Operator	3	53	4.42	0.02
DO. SCHILDE CO.				3	53	4.42	
CE VERCON COMP			Operator				
dd. Remove Sampling/Verling Rig 10			Operator	2	-60		
ne. Install Lid Handling Device 25	25	2	Operators	_2	60		
. 1808 00.10.10.10	10	1	Rooman	10	8.7	1.45	0.04
	10		Crone Operator	20	0.5	0.08	0.04
				2	- 60		
f. Loosen Cosk Lid Bolls 90			Operators				
	20	1	Regman	10	2.7	2.90	
	20	1	Crane Operator	20	0.5	0.17	0.08
Attack Interface Drives	30	2	Operators	2	60	8	0.25
30 /0/00/1994/000/1004			Operator	6	2.7	1.45	0.04
TIP. WELLDOW PURCHIL						900	
L. Operators Clear Prep Room			Operators	0	9		
Move Ctalk Under Cell Port	0	0	Remote	0	0		
Mr. Mate Cark to Port 30	0		Remote	O	0	0.00	0.00
A Comp Dest and Demons Cosk Hd	O		Remote	O	0	0.00	0.00
L CONTROL OF CONTROL O			RE-10-10	_		507	E
Fotal : 73.	825			-			
	<u> </u>						
1b. Receive & Prep Loaded Rail Cask (only SPS technology) to Unio	ad					bocks	
15. Receive a risp process from to set of markets : 1.	-	other	from walk-around petip	***)		
			Operator	Đ	0	0.00	0.00
a. Inspect Bills of Loding, Other Shipping Papers 10				_	0.5	0.04	
h. Pull Conkinto Security Area			Prime Mover Operator				
c Secretly Inspection (specific)	25		Security Officers	_2	17	14.17	
cl. Perform HP Survey of Cosk Externals and Trailer (s-perfm) : 35	10	2	Radiation Protection	2	43	14.33	0.00
d. Perform HP SLEVEY of Cost Externols disc include Coperaty			Prime Mover Operator	_	0.5	0.08	0.00
e. loke Cost to Protected Aved					0.5		
f. Unititch Off-Site Prime Mover 10	1		Prime Mover Operator				
G Mich Ste Prime Mover			Prime Mover Operator		0.5	0.08	
h. Take Cask to Receiving and Shipping Bay Door 10	10	1	Prime Mover Operator	15	0.5	0.08	0.00
To both Cost to Receive & Cost of the Street	0	•	Operator	o	0	98	0.00
hit. Open Receiving and Shoping Bay Door, simultaneous			Prime Mover Operator	15	0.5	0.04	0.00
L. Take Cask into Receiving and Shipping Bay				_	8.7	2.73	0.00
	5		Rogman	10			
J. Urrhitch Site Prime Mover 10	10	1 1	Prime Mover Operator	15	0.5	0.08	8
(1). Close Receiving and Shipping Bay Door.	1	,				0.00	0.00
11. Close Received dry a control	0	1	Operator	0	٥	0.00	0.00
smulticreculty with			Operators	3	32		
k. Remove Personnel Borrier (sperim) 3						0.21	0.10
(cassume crome enclosure background dose)	25		Crane Operator	20	0.5		
L HP Survey (s-cliameter)	45	2	Radiation Protection	2	43		
m. Remove impact Limiters (s-clameter) 110	110	2	Operators	3	32	117.33	0.92
m. Remove impact unities (Falcinetes)	110		Crane Operator	20	0.5	0.92	0.46
				3	32		
rs. Remove Tieclowns (s-perim)			Operators				
	45		Crane Operator	20	0.5	0.38	
o, Remove Taumion Books	10	2	Operators	3	32	10.67	
G. National III Control	10	1	Crane Operator	20	0.5	0.08	0.04
	To		Operator	0	0	0.00	0.00
 Open SNF Transport Cask Prep Room Door, simultaneous 				2	- 6	0.00	
p. Attach Crone to Yoke	5 5		Operator	10	- 6		0.02
	5		Riagman			0.00	
	5	1			_		
	5 5		Crane Operator	20	0	0.00	0.02
				20	_	0.00	
q. Engage Yoke to Calk		1	Operator	20 2	0 17	1.42	0.02
q. Engage Yoke to Calk	5	1	Operator Ragman	20 2 10	0 17 8.7	1.42 0.73	0.02
d shope tone to com		1	Operator	20 2	0 17	1.42 0.73 0.04	0.02 0.02 0.02
d shope tone to com	5	1	Operator Ragman	20 2 10	0 17 8.7	1.42 0.73	0.02 0.02 0.02
r. Move Cask Into SNF Transport Cask Prep Room	5		Operator Ragman Crarie Operator	20 2 10	0 17 8.7 0.5	1.42 0.73 0.04 0.00	0.02 0.02 0.02 0.00
C. Move Cask Into SNF Transport Cask Prep Room	5 5		Operator Rogmon Crane Operator Operators	20 2 10 20	0 17 8.7 0.5	1.42 0.73 0.04 0.00 0.60	0.02 0.02 0.02 0.00
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area	5 5 0 10		Operator Ragman Crarse Operator Operators Crarse Operators	20 20 10 20 10 20	0 17 8.7 0.5 1.8	1.42 0.73 0.04 0.00 0.60	0.02 0.02 0.02 0.00 0.06
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform	5 5 0 10 10		Operator Ragman Crarse Operator Operators Crarse Operator Operators Crarse Operator	20 20 20 20 10 20 6	0 17 8.7 0.5 1.8 0.5	1.42 0.73 0.04 0.00 0.60 0.60	0.02 0.02 0.02 0.00 0.06 0.06
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1 9. Washdown Cask (s-dameter) 5	5 5 10 10 0 10 5 45		Operator Ragman Crarse Operator Operators Crarse Operator Operator Operator Operator	20 20 10 20 10 20 20 6	0 17 8.7 0.5 1.8 0.5 8.7	1.42 0.73 0.04 0.00 0.00 0.00 1.45 25.50	0.02 0.02 0.02 0.00 0.06 0.04 0.04
r. Move Cask Into SNF Iransport Cask Prep Room Washdown Area s. Install Platform 1: Washdown Cask (s-dameter) 5	5 5 10 10 0 10 5 45		Operator Ragman Crarse Operator Operators Crarse Operator Operators Crarse Operator	20 20 20 20 10 20 6	0 17 8.7 0.5 1.8 0.5 8.7 17	142 0.73 0.04 0.00 0.60 0.06 145 25.50 43.00	0.02 0.02 0.02 0.00 0.04 0.04 0.38
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1: Washdown Cask (s-dameter) 5: U. HP Sarvey (s-dameter) 6: 8	5 5 10 10 0 10 5 45 5 30		Operator Ragman Crane Operator Operators Crane Operator Operator Operator Operator Radiation Protection	20 20 10 20 10 20 20 6	0 17 8.7 0.5 1.8 0.5 8.7 17	142 0.73 0.04 0.00 0.60 0.06 145 25.50 43.00	0.02 0.02 0.02 0.00 0.04 0.04 0.38
T. Move Cask Into SNF Transport Cask Prep Room Washdown Ared It Install Platform T. Washdown Cask (o-diameter) L. HP Survey (o-diameter) V. Bernove Platform It	5 5 10 10 10 5 45 5 30		Operator Ragman Crarse Operator Operators Crarse Operator Operator Operator Operator Radiation Protection Operator	20 10 20 10 20 6 20 6	0 17 8.7 0.5 1.8 0.5 8.7 17 43 8.7	1.42 0.73 0.04 0.00 0.60 0.06 1.45 25.50 43.00 1.45	0.02 0.02 0.02 0.06 0.06 0.04 0.38 0.25
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1: Washdown Cask (s-dameter) 5: U. HP Sarvey (s-dameter) 6: 8	5 5 10 10 10 5 45 5 30 10 10 10 10 10 10 10 10 10 10 10 10 10		Operator Ragman Crane Operator Operator Crane Operator	20 10 20 10 20 6 2 2 2 10	0 17 8.7 0.5 1.8 0.5 8.7 17 43 8.7	1.42 0.73 0.04 0.60 0.60 1.45 25.50 43.00 1.46	0.02 0.02 0.00 0.06 0.04 0.38 0.25
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1: Washdown Cask (s-diameter) 5: U. HP Survey (s-diameter) 6: Remove Platform 7: W. Move Transport Cask to Carrier	5 5 0 10 10 0 10 5 45 5 30 0 10 0 10		Operator Ragman Crarse Operator Operator Operator Operator Operator Operator Radiation Protection Operator Operator Operator Operator Operator	20 20 20 20 20 6 20 6 22 2 10 20	0 17 8.7 0.5 0.5 8.7 17 43 8.7 1.8	1.42 0.73 0.04 0.00 0.00 1.45 25.50 43.00 1.46 0.08	0.02 0.02 0.00 0.06 0.04 0.38 0.25 0.04
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1: Washdown Cask (s-diameter) 5: U. HP Survey (s-diameter) 6: Remove Platform 7: W. Move Transport Cask to Carrier	55 55 100 100 100 100 100 100 100 100 10		Operator Ragman Crarse Operator Operator Operator Operator Operator Radiotion Protection Operator	20 20 20 20 6 20 6 20 6 10 20	0 17 8.7 0.5 0.5 8.7 17 43 8.7 1.8 0.5 8.7	1.42 0.73 0.04 0.00 0.08 1.45 25.50 43.00 1.46 0.60 0.08	0.02 0.02 0.00 0.06 0.04 0.38 0.25 0.04 0.04
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1: Washdown Cask (s-diameter) 5: U. HP Survey (s-diameter) 6: Remove Platform 1: Wove Transport Cask to Carrier	5 5 0 10 10 0 10 5 45 5 30 0 10 0 10		Operator Ragman Crarse Operator	20 20 20 20 20 6 20 20 10 20 10	0 17 8.7 0.5 1.8 0.5 8.7 17 43 8.7 1.8 0.5 8.7 0.5	1.42 0.73 0.04 0.00 0.60 1.45 25.50 43.00 1.45 0.60 0.08 5.80	0.02 0.02 0.00 0.00 0.04 0.04 0.25 0.04 0.06 0.04
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1: Washdown Cask (s-diameter) 5: Lt HP Survey (s-diameter) 6: Remove Ratform 7: Wove Transport Cask to Carrier 7: Rooe Transport Cask on Carrier 7: Rooe Transport Cask on Carrier 7: Rooe Transport Cask on Carrier	5 5 5 100 100 100 100 100 100 100 100 200 200		Operator Ragman Crarse Operator Operators Crarse Operator Oranse Operator Operators Operators Operators Operators Operators	20 20 20 20 6 20 6 20 6 10 20	0 17 8.7 0.5 0.5 8.7 17 43 8.7 1.8 0.5 8.7	1.42 0.73 0.04 0.00 0.60 1.45 25.50 43.00 1.46 0.60 0.08 5.80 0.17 28.67	0.02 0.02 0.00 0.00 0.04 0.04 0.25 0.04 0.06 0.04 0.07
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area 1: s. Install Platform 1: t. Washdown Cask (o-diameter) 5: u. HP Survey (o-diameter) 6: v. Remove Platform 1: w. Move Transport Cask to Carrier 1: x. Roce Transport Cask on Carrier 2: v. Secure Cask to Carrier (o-certim) 2:	5 5 5 100 100 100 100 100 100 100 100 200 200		Operator Ragman Crarse Operator Operators Crarse Operator Operator Operator Radiation Protection Operator Operator Operator Operator Operator Crarse Operator Operators Crarse Operator Operators Operators Operators Operators Operator Operator	20 10 20 10 20 6 20 20 10 20 10 20	0 17 8.7 0.5 0.5 8.7 17 43 8.7 1.8 0.5 8.7 0.5 8.7 0.5	1.42 0.73 0.04 0.00 0.60 1.45 25.50 43.00 1.46 0.60 0.08 5.80 0.17 28.67	0.02 0.02 0.00 0.00 0.04 0.04 0.25 0.04 0.06 0.04 0.07
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1: Washdown Cask (s-diameter) 5: Lt HP Survey (s-diameter) 6: Remove Ratform 7: Wove Transport Cask to Carrier 7: Rooe Transport Cask on Carrier 7: Rooe Transport Cask on Carrier 7: Rooe Transport Cask on Carrier	5 5 5 10 10 10 10 10 10 10 10 10 10 10 10 10		Operator Ragman Crane Operator	20 10 20 20 20 20 20 20 20 20 20 20 20 20	0 17 8.7 0.5 0.5 8.7 17 43 8.7 1.8 0.5 8.7 0.5	1.42 0.73 0.04 0.00 0.60 1.45 25.50 43.00 1.45 0.08 5.80 0.17 28.67 2.83	0.02 0.02 0.00 0.04 0.04 0.08 0.04 0.08 0.04 0.07 0.07
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area 1: s. Install Platform 1: t. Washdown Cask (o-diameter) 5: u. HP Survey (o-diameter) 6: v. Remove Platform 1: w. Move Transport Cask to Carrier 1: x. Roce Transport Cask on Carrier 2: v. Secure Cask to Carrier (o-certim) 2:	5 5 5 10 10 10 10 10 10 10 10 10 10 10 10 10		Operator Ragman Crarse Operator Operator Operator Operator Radiation Protection Operator	20 10 20 20 20 6 2 20 20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	0 17 8.7 0.5 0.5 8.7 17 43 8.7 1.8 0.5 8.7 0.5 43 43	1.42 0.73 0.04 0.00 0.60 1.45 25.50 43.00 1.45 0.60 0.08 5.80 0.17 28.67 2.83	0.02 0.02 0.00 0.04 0.04 0.08 0.04 0.09 0.04 0.07 0.07 0.09
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1: Washdown Cask (s-diameter) 5: U. HP Survey (s-diameter) 6: Remove Ratform 7: Wove Transport Cask to Carrier 7: Recoe Transport Cask to Carrier 7: X. Race Transport Cask on Carrier 7: Y. Secure Cask to Carrier (s-perfm) 7: YI. Disengage Crane with Yoke from Cask, simultaneous	55 50 100 100 100 100 100 100 200 200 200 20		Operator Ragman Crarse Operator	20 10 20 20 20 6 6 10 20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	0 17 8.7 0.5 8.7 17 43 8.7 1.8 0.5 8.7 0.5 43 1.8 0.5 0.5	1.42 0.73 0.04 0.00 0.06 1.45 25.50 43.00 0.08 5.80 0.17 28.67 28.67	0.02 0.02 0.00 0.04 0.04 0.25 0.04 0.06 0.17 0.06 0.17
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1: Washdown Cask (s-diameter) 5: U. HP Survey (s-diameter) 6: Remove Ratform 7: Wove Transport Cask to Carrier 7: Recoe Transport Cask to Carrier 7: X. Race Transport Cask on Carrier 7: Y. Secure Cask to Carrier (s-perfm) 7: YI. Disengage Crane with Yoke from Cask, simultaneous	5 5 5 10 10 10 10 10 10 10 10 10 10 10 10 10		Operator Ragman Crarse Operator Operator Operator Operator Radiation Protection Operator	20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	0,05 17,05 0,5 8,7 17,43 8,7,18,05,5 8,7,18,05,5 8,7,18,05,5 1,7,18,05,00,00	1.42 0.73 0.04 0.00 0.60 1.45 25.50 1.45 0.60 0.08 5.80 0.17 28.67 2.83 1.45	0.02 0.02 0.00 0.04 0.04 0.04 0.04 0.04
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1: Washdown Cask (s-diameter) 5: U. HP Survey (s-diameter) 6: Remove Ratform 7: Remove Ratform 8: Move Transport Cask to Carrier 7: Record Transport Cask on Carrier 7: Secure Cask to Carrier (s-perim) 7: Secure Cask to Carrier (s-perim) 7: Disengage Crane with Yoke from Cask, simultaneous 7: Close SNF Transport Cask Prep Room Door, simultaneous	55 55 100 100 100 100 100 100 100 100 200 200		Operator Ragman Crarse Operator Operators Crarse Operator Operator Operator Radiation Protection Operator	20 10 20 20 20 6 6 10 20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	0,05 17,05 0,5 8,7 17,43 8,7,18,05,5 8,7,18,05,5 8,7,18,05,5 1,7,18,05,00,00	1.42 0.73 0.04 0.00 0.60 1.45 25.50 1.45 0.60 0.08 5.80 0.17 28.67 2.83 1.45	0.02 0.02 0.00 0.04 0.04 0.04 0.04 0.04
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area 1 s. Install Platform 1 t. Washdown Cask (o-diameter) 5 u. HP Survey (o-diameter) 6 v. Remove Platform 1 w. Move Transport Cask to Carrier 1 x. Race Transport Cask on Carrier 2 y. Secure Cask to Carrier (o-perim) 2 yt. Disengage Crane with Yoke from Cask, simultaneous 2 install Shield Platform 3	55 55 100 100 100 100 100 100 100 100 10		Operator Ragman Crarse Operator Operators Crarse Operator	20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	0 17 8.7 0.5 1.8 8.7 17 43 8.7 0.5 8.7 0.5 43 17 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 8.7 0.5 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	1,42 0,73 0,04 0,00 0,08 1,45 25,50 43,00 1,45 0,60 0,08 5,80 0,17 28,67 2,83 1,45 0,00 0,00 0,00 0,00 0,00 0,00 0,00 0	0.02 0.02 0.03 0.04 0.04 0.04 0.04 0.04 0.04 0.04
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area 1. Install Platform 1. Washdown Cask (s-diameter) 2. Washdown Cask (s-diameter) 3. Remove Platform W. Move Transport Cask to Carrier X. Place Transport Cask to Carrier y. Secure Cask to Carrier (s-perim) y1. Disengage Crane with Yoke from Cask, simultaneous y2. Close SNF Transport Cask Prep Room Door, simultaneous 2. Install Shield Platform and. Attach Gas Compling/Venting Rig 1.	55 55 100 100 100 100 100 100 100 100 10		Operator Ragman Crarse Operator Operators Crarse Operator Operator Operator Operator Operator Operator Operator Operators Oranse Operator Operators Oranse Operator	20 20 20 20 20 20 20 20 20 20 20 20 20 2	0 17 8.7 0.5 0.5 8.7 17 43 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	1.42 0.73 0.04 0.00 0.60 1.45 25.50 43.00 0.08 5.80 0.01 7.28.67 2.83 1.45 0.08 0.08	0.02 0.00 0.00 0.00 0.00 0.00 0.00 0.00
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1: Washdown Cask (s-dameter) 5: U. HP Survey (s-diameter) 6: U. HP Survey (s-diameter) 7: Remove Platform 8: Move Transport Cask to Carrier 8: Place Transport Cask to Carrier 9: Secure Cask to Carrier (s-perim) 9: Disengage Crane with Yake from Cask, simultaneous 9: V2: Close SNF Transport Cask Prep Room Door, simultaneous 2: Install Shield Platform 1: Cask Prep Room Door, simultaneous 1: Cask Platform 1: Cask Prep Room Door, simultaneous 2: Cask Prep Room Door, simultaneous 1: Cask Prep Room Door, simultaneous 1: Cask Prep Room Door, simultaneous 1: Cask Prep Room Door, simultaneous 2: Cask Prep Room Door, simultaneous 3: Cask Prep Room Door, simultaneous 3: Cask Prep Room Door, simultaneous 4: Cask Prep Room Door, simultaneous 5: Cask Prep Room Door, simultaneous 6: C	55 55 100 100 100 100 100 100 100 100 10		Operator Ragman Crarse Operator Operators Oranse Operator Operator Operator Radiation Protection Operators Operators Operators Operators Operators Operator	20 20 20 20 20 20 20 20 20 20 20 20 20 2	0.5 177 0.5 1.8 0.5 8.7 1.7 4.3 8.7 1.8 8.7 0.5 4.3 1.7 0.5 6.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	1.42 0.73 0.04 0.00 0.08 1.45 25.50 43.00 1.45 0.60 0.08 5.80 0.17 28.67 2.83 1.45 0.00 0.00 4.00 0.00 0.00 0.00 0.00 0	0.02 0.00 0.00 0.00 0.00 0.00 0.00 0.00
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1: Washdown Cask (s-dameter) 5: U. HP Survey (s-diameter) 6: U. HP Survey (s-diameter) 7: Remove Platform 8: Move Transport Cask to Carrier 8: Place Transport Cask to Carrier 9: Secure Cask to Carrier (s-perim) 9: Disengage Crane with Yake from Cask, simultaneous 9: V2: Close SNF Transport Cask Prep Room Door, simultaneous 2: Install Shield Platform 1: Cask Prep Room Door, simultaneous 1: Cask Platform 1: Cask Prep Room Door, simultaneous 2: Cask Prep Room Door, simultaneous 1: Cask Prep Room Door, simultaneous 1: Cask Prep Room Door, simultaneous 1: Cask Prep Room Door, simultaneous 2: Cask Prep Room Door, simultaneous 3: Cask Prep Room Door, simultaneous 3: Cask Prep Room Door, simultaneous 4: Cask Prep Room Door, simultaneous 5: Cask Prep Room Door, simultaneous 6: C	55 55 100 100 100 100 100 100 100 100 10		Operator Ragman Crarse Operator Operators Crarse Operator Operator Operator Operator Operator Operator Operator Operators Oranse Operator Operators Oranse Operator	20 20 20 20 20 20 20 20 20 20 20 20 20 2	0 177 4.7 0.5 0.5 8.7 17 43 8.7 0.5 8.7 0.5 43 17 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	1.42 0.73 0.04 0.00 0.08 1.45 25.50 43.00 1.45 0.08 5.80 0.17 28.63 1.45 0.08 0.00 4.35 10.08	0.02 0.02 0.00 0.00 0.00 0.00 0.00 0.00
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1. Washdown Cask (s-diameter) 5. U. HP Survey (s-diameter) 6. U. HP Survey (s-diameter) 7. Remove Platform 8. Move Transport Cask to Carrier 7. Place Transport Cask to Carrier 7. Place Transport Cask on Carrier 7. Secure Cask to Carrier (s-perim) 7. Disengage Crane with Yoke from Cask, simultaneous 7. Install Shield Platform 7. Cask Cask SNF Transport Cask Prep Room Door, simultaneous 7. Install Shield Platform 7. Sample Gas Carrier(s-perim) 8. Sample Gas Carrier(s-perim) 9. Sample Gas Carrier(s-perim) 9. Cask Cask Cask Sylvertiang Rig 9. Sample Gas Cask Sylvertiang Rig 9. Sample Gas Cask Sylvertiane	55 55 100 100 100 100 100 100 100 100 10		Operator Ragman Crarse Operator Operators Crarse Operator Operator Operator Radiation Protection Operator Operator Operator Operators Crarse Operator Operators Oranse Operator	20 20 20 20 20 20 20 20 20 20 20 20 20 2	0 177 4.7 0.5 0.5 8.7 17 43 8.7 0.5 8.7 0.5 43 17 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	1.42 0.73 0.04 0.00 0.08 1.45 25.50 43.00 1.45 0.08 5.80 0.17 28.63 1.45 0.00 4.35 10.00 4.42 8.83	0.02 0.02 0.00 0.00 0.00 0.00 0.00 0.00
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1. Washdown Cask (s-diameter) 5. U. HP Survey (s-diameter) 6. Remove Platform 7. Remove Platform 8. Move Transport Cask to Carrier 7. Place Transport Cask to Carrier 7. Place Transport Cask on Carrier 7. Secure Cask to Carrier (s-perim) 7. Disengage Crane with Yoke from Cask, simultaneous 7. Install Shield Platform 7. Install Shield Platform 8. Attach Gas Sampling/Venting Rig 9. Disengage Cask (s-cask) (55 55 100 100 100 100 100 100 100 100 10		Operator Ragman Crarse Operator Operators Crarse Operator Operator Operator Operator Radiation Protection Operator	20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	0 177 8.7 0.5 0.5 8.7 17 43 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	1.42 0.73 0.04 0.00 0.00 1.45 25.50 43.00 1.45 0.60 0.08 0.17 28.67 2.83 1.45 0.00 0.00 4.35 10.00	0.02 0.02 0.02 0.00 0.00 0.00 0.00 0.00
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area 1 s. Install Platform 1 t. Washdown Cask (o-diameter) 5 u. HP Survey (o-diameter) 6 V. Remove Profitorm 1 w. Move Transport Cask to Carrier 1 x. Race Transport Cask to Carrier 2 y. Secure Cask to Carrier (o-perim) 2 yt. Disengage Crane with Yoke from Cask, simultaneous 2 yt. Disengage Crane with Yoke from Cask, simultaneous 2 z. Install Shield Platform 3 aa. Affach Gas Sampling/Venting Rig 1 bb. Sample Gas Covity (o-diameter) 1 dct. Remove Sampling/Venting Rig 1	55 55 100 100 100 100 100 100 100 100 10		Operator Ragman Crarse Operator Operators Crarse Operator Operator Operator Operator Operator Operator Operator Operator Operators Operators Operators Operators Operator	20 20 20 20 20 20 20 20 20 20 20 20 20 2	0 177 4.7 0.5 0.5 8.7 17 1.8 0.5 8.7 1.8 0.5 8.7 1.7 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	1.42 0.73 0.04 0.00 0.00 1.45 25.50 43.00 0.08 5.80 0.07 28.67 2.83 1.45 0.00 4.42 4.35 10.00 4.42 10.00 5.00 5.00	0.02 0.02 0.02 0.06 0.06 0.06 0.08 0.08 0.08 0.09 0.00 0.00 0.00 0.00
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1. Washdown Cask (s-diameter) 5. U. HP Survey (s-diameter) 6. Remove Platform 7. Remove Platform 8. Move Transport Cask to Carrier 7. Place Transport Cask to Carrier 7. Place Transport Cask on Carrier 7. Secure Cask to Carrier (s-perim) 7. Disengage Crane with Yoke from Cask, simultaneous 7. Install Shield Platform 7. Install Shield Platform 8. Attach Gas Sampling/Venting Rig 9. Disengage Cask (s-cask) (55 55 100 100 100 100 100 100 100 100 10		Operator Ragman Crarse Operator Operators Crarse Operator Operator Operator Operator Operator Operator Operators Operators Operators Operators Operator	20 20 20 20 20 20 20 20 20 20 20 20 20 2	0 177 4.7 0.5 0.5 8.7 17 0.5 8.7 0.5 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	1.42 0.73 0.04 0.00 0.60 0.08 1.45 25.50 0.08 5.80 0.08 5.80 0.08 1.45 0.08 0.08 1.45 0.08 0.08 1.45 0.08 0.08	0.02 0.02 0.02 0.02 0.06 0.06 0.06 0.06
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1. Washdown Cask (s-diameter) 5. U. HP Survey (s-diameter) 6. Remove Platform 7. Remove Platform 8. Move Transport Cask to Carrier 7. Place Transport Cask to Carrier 7. Place Transport Cask on Carrier 7. Secure Cask to Carrier (s-perim) 7. Disengage Crane with Yoke from Cask, simultaneous 7. Install Shield Platform 7. Install Shield Platform 8. Attach Gas Sampling/Venting Rig 9. Disengage Cask (s-cask) (55 55 100 100 100 100 100 100 100 100 10		Operator Ragman Crarse Operator Operators Operator	20 20 20 20 20 20 20 20 20 20 20 20 20 2	0 177 4.7 0.5 0.5 8.7 1.8 0.5 8.7 1.8 0.5 8.7 0.5 43 17.7 0.6 6.7 6.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0	1.42 0.73 0.04 0.00 0.08 1.45 25.50 43.00 0.08 5.80 0.08 5.80 0.08 0.08 0.08 0	0.022 0.022
r. Move Cask Into SNF Transport Cask Prep Room Washdown Area s. Install Platform 1. Washdown Cask (s-diameter) 5. U. HP Survey (s-diameter) 6. Remove Platform 7. Remove Platform 8. Move Transport Cask to Carrier 7. Place Transport Cask to Carrier 7. Place Transport Cask on Carrier 7. Secure Cask to Carrier (s-perim) 7. Disengage Crane with Yoke from Cask, simultaneous 7. Install Shield Platform 7. Install Shield Platform 8. Attach Gas Sampling/Venting Rig 9. Disengage Cask (s-cask) (5 5 5 5 100 100 100 100 100 100 100 100		Operator Ragman Crarse Operator Operators Crarse Operator Operator Operator Operator Operator Operator Operators Operators Operators Operators Operator	20 20 20 20 20 20 20 20 20 20 20 20 20 2	0 177 4.7 0.5 0.5 8.7 1.8 0.5 8.7 1.8 0.5 8.7 0.5 43 17.7 0.6 6.7 6.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0	1.42 0.73 0.04 0.00 0.08 1.45 25.50 43.00 0.08 5.80 0.08 5.80 0.08 0.08 0.08 0	0.02 0.02 0.02 0.06 0.06 0.06 0.06 0.06

Table A1-5. MRS-Reference (continued)

						0.5	0.17	0.0
		20		Crone Operator	20	40		
ag. Attach Interface Picture	30	30		Operators	2	8.7	1.45	
h. Remove Platform	10	10		Operator Operators	8	0	0.00	
Operators Clear Frep Room	5	8		Remote		0	0.00	
Move Cask Under Cell Port	30	- 0		Remote	尚	0	0.00	
dr. Male Cark to Post	30				尚	0	0.00	
Open Port and Remove Calk Ltd		1,025	 4	Remote	—≝		451	5.7
old		1.00						-
;	∔		-		- 1			\vdash
Bacelve and Prep Unloaded Slorage, Emplacement er				asume ruli bacigrour	المسا			
Transportation Can't for Loading					<u> </u>		0.00	0.0
n. Inspect Bills of Lading, Other Shipping Papers	10	10		Operator	15		0.00	_
p. Pull Cask into Security Area	5	5		Prime Mover Operator		읫	9.00	_
Security Inspection	30	30		Security Officers	2	의		
d. Perform HP Survey of Cark Externals and Trailer	30	30		Radiation Protection	_2	9	0.00	
Take Cark to Protected Area	10	10		Prime Mover Operator		_ 0	0.00	_
Linhlich Off-Ste Prime Mover	10	10		Prime Mover Operator		0	0.00	
rs. Hitich Ste Prime Mixwer	10	10		Prime Mover Operator		9	0.00	
n. Take Cask to Receiving and Shipping Bay Door	10	10		Prime Mover Operator		0	0.00	
h1. Open Receiving and Shipping Boy Door, simultaneous		0		Operator	_0	0	0.00	
Take Cask into Receiving and Shipping Bay	5	5		Prime Mover Operator		9	0.00	
		0	1	Rooman	10	0	0.00	
L Unit tich Site Prime Mover	10	10		Pirne Mover Operator		0	0.00	
fl. Close Receiving and Shipping Bay Door, simultaneous;	-+	0		Operator	0	0	0.00	-
n. Remove Tedownii	50	50		Operators	3	0	0.00	0.4
	10	10		Operators	3	0	0.00	a
o. Remove Trunnion Blocks	——••	- 10		Crane Operator	20	0	0.00	0.0
On the Property Control Control Control Control	 +			Operator	- 6	0	0.00	
o1. Open SNF Transport Cosk Prep Room Door, simultanea	5	5		Operator	2	ŏ	0.00	
p. Attach Crane to Yake		- 3			10	- 6	0.00	
		- 3		Crone Operator	20	ő	0.00	
	5	5		Operator	2	O	0.00	_
a. Engage Yoke to Cask					10	- 8	0.00	_
		- 5		Rogman	20	- 3	0.00	_
	├	5		Crane Operator	العب		0.00	
r. Move Cask Into SNF Transport Cask Prep Room							930	
Washdown Area	30	30		Operators	10	9	_	_
	30	30		Crane Operator	20	0	0.00	
s. Install Platform	10	10		Operator	6	0	0.00	
t. Washdown Cask	30	30		Operator	2	0	0.00	
u. HP Survey	15	35	2	Radiation Protection	2	0	0.00	
v. Remove Platform	10	10	1	Operator	6	٥	0.00	
w. Move Transport Cask to Carrier	10	10	2	Operators	10	0	0.00	_
		10	1	Crane Operator	20	0		
x. Place Transport Clark on Carrier	20	20	2	Operators	: 10	9	0.00	
		20	1	Crane Operator	20	0	0.00	
y. Secure Cask to Cizrier	20	20	2	Operator	. 2	0	0.00	
<u>y </u>	. ;	20	1	Crane Operator	20	0	0.00	_
y1. Close SNF Transport Cask Prep Room Door							200	O.O
sinuffareoutly with y		0	1	Operator	. 0	0	0.00	0.0
z. Instal Stield Platform	: ::0	30		Operator	- 6	0	0.00	0.
	: 60	60		Operators	2	0	0.00	0.5
CICI. Leosen Cosk Lici Bolts	:3	25		Operators	2	0	0.00	0.
bb. Install Lid Hamaling Device	io	30		Operators	2	ŏ	0.00	
cc. Affach Meriacie Route	10	10		Operator	6		0.00	
ctd. Remove Platfalm	5				1 8			
ee. Operators Clear Prep Room	5			Remote	- 3			
ff. Move Cosk Under Cell Port		30		Remote	ő			
gg. Male Cask to Port	<u> </u>				岗			
Nh. Open Port and Remove Cask Ud	10	30		Remote	۳		0.00	_
Total	£10	490	نــــا	ļ				-
								
3. Load/Unload SNF (Transfer)	ليــــن		ليسا				0.00	-
a. Install a Spacer	. 20		_	Remote				
b. Get 8are SNF Grapple	10			Remote	0			
c. Get and inspect One bare SNF assembly	10	_		Remote	_ 0			_
d. Emplace Bare SNF assembly if necessary	10			Remote	. 0			
e. Ruf Bare SNF in Clan	<u>. 20</u>	0		Remote	<u> </u>		_	
1. Install Can Lid				Remote	. 0	0		_
Total	100	0		ļ	<u>:</u>	ļ	0.00	0.
]			لب	لـــا	لسيا	
4. Prep DVCC Storage Cask from SNF Transfer Cell for Storage	10			assume crane enclosu			una _	1_
cs. From Cell, Install MPC Shield Plug	. 25	0		Remote	-0			
b. Replace Part Plug	10		0	Remote	0	_		
c. Unincle Storage Calk from Part	10	0	0	Remote	0			
d. Open Transfer Station Door	5	D		Operator	0			
	30		1	Operator	10	8.7		
e. Move Cosk into Storoge Cosk Preci Room				Radiation Protection	2	59	59.00	0.
e. Move Cask Into Storage Cask Prep Room	60	30	2	- Independent Francisco				
e. Move Cask Into Storage Cask Prep Room f. HP Survey				Operators	2		64.67	
e. Move Cask Into Storage Cask Prep Room	- 60		2			97	64.67	_

Table A1-5. MRS-Reference (continued)

	Ţ	0	, ,	Operator	C	Ó	0.00 0.00
g1. Close Teamsfer Station Door, simultaneous h. Secure Cask Bolled Ltd	30	30		Operators	2		
L Connect Evacuation/Inerling Equipment	. 30	10		Operator	2	97	16.17 0.04
J. Evacuate and Inert Cask	45	10		Operator	2	37	6.17 0.04
		45	1	Operator	10	8.7	6.53 0.19
k. Disconnect Evacuation/Inerling Equipment	5	5		Operator	2	97	8.08 0.02
L Place and Seal Weld Valve Cover	90	8		Welder	2	97	145.50 0.36
m. Piace Storage Outer Lid	30	30		Operator	2	97	48.50 0.13
	•	30		Ragman	10	8.7 0.5	4.35 0.13 0.25 0.13
	45	30 45		Crane Operator Welder	2	70	
n. Soft p Remote Welding Equipment	600		-			- 70	0.00 0.00
o. Weld Storage Casts Outer tid p. Verify Storage Casts Outer tid Weld	- 60	30		QA Welder	. 2	70	
g Remove Remote Welding Equipment	20	20		Welder	2	70	
c. NP Survey Cook	60	30		Radiation Protection	2	59	59.00 0.25
s. Open Storage Cask Prep Room Door	5	0	7	Operator	0	0	0.00 0.00
1. Move Cask to Storage Cask Staging Area	30	30		Operator	10	8.7	4.35 0.13
	1	30		Transporter Operator	15	0.5	0.25 0.13
L. Close Storage Cark Prep Room Door	5	0		Operator	2	0 59	19.67 0.08
v. Unsecure Cosk from Coxier	10 : 60	10 30		Operators Operators	2	59	59.00 0.25
w. Engage Storage Cask with Transporter	: 60	30		Transporter Operator	15	0.5	0.25 0.13
Control Toronto	20	20		Operators	2	59	
2 Section Control of the section of	60	30		Operators	10	8.7	8.70 0.00
y. Move Cask to Storage Yard (rull background dose while moving)	; ~	60		Transporter Operator	15	0.5	0.50 0.00
U.S. DOLLAR OF THE STREET		30		Radiation Protection	10	8.7	4.35 0.00
z. Unsecure Cask from Transporter	: 20	10		Operators	2	59	19.67 0.67
	!	20		Transporter Operator	15	0.5	0.17 0.67
	1	10		Radiation Protection	10	8.7	1.45 0.33
ca. Place Storage Cask on Pad	60	30		Operators	2	59	
		- 60		Transporter Operator Radiation Protection	15	0.5	0.50 2.00 4.35 1.00
		30			10	8.7	0.00 0.00
bb. Return Transport to Transfer Facility	50	<u>25</u> 25		Operators Transporter Operator	15	8	0.00 0.00
(without a cask and inuli background dose)	:	25		Radiation Protection	10	- 6	0.00 0.00
 	1480			ROSSINS IT IS ISSUED			863 10
Total	:	.,					
5 Prep Unloaded Cask from SNF Transfer to Shipping				casume crone enclosus	• bo	ckgrou	nd dose
a. Replace Cask Lid	20	20		Operators	2	0	0.00 0.17
	7	20		Operator	10	0	0.00 0.06
	i	20		Crane Operator	20	0	0.00 0.06
b. Replace Parl Plug	30	0		Operators	2		0.00 0.06
	+	10		Operator Crane Operator	10 20	0	0.00 0.04
	10	10		Remote	~	0	0.00 0.00
c. Unmale Cask from Part d. Open Transfer Station Door	5	- 6		Operator	- 8	- 6	0.00 0.02
e. Move Coak Into SNF Transport Coak Prep Room	10	10		Operators	10	0	0.00 0.06
1. Close Transfer Station Door	. 5	5		Operator	0	0	0.00 0.03
g. Install Shield Platform	30	30	1	Operator	- 6	0	0.00 0.33
h. Remove interface Foture	30	30		Operators	_2	0	0.00 0.25
Ł Remove Cask Lid Handling Device	25	25		Operators	2	0	0.00 0.21
		25		Ragman	10	0	0.00 0.10
	- 40	25		Crane Operator	20	0	0.00 0.50
J. Install Coak Ud	- 60	60		Operators Rogman	10	- 8	0.00 0.25
	+ -	- 60		Crane Operator	20	- 6	0.00 0.25
k, Test Calk Closure	45	45		Operators	2	- 6	0.00 0.38
L HP Survey Cook	1 30	30		Radiation Protection	2	0	0.00 0.25
m. Remove Shield Platform	10	10		Operator	6	0	0.00 0.04
m1, Unsecure Cosk from Corrier, simultaneous							0.00 0.00
n. Attach Cione to Yake	<u>;</u> 5	5		Operator	_2	0	0.00 0.02
		5		Rooman	3	0	000 000
		5		Crane Operator	20	의	0.00 0.02
n1. Open Prep Room Door, smultaneous	5			Operator	2	0	0.00 0.02
o. Engage Yake to Cask	. 3	5		Operator Rogman	10	- 8	0.00 0.02
	-	5			20	Ö	0.00 0.02
p. Lift Cask out of Prep Room onto Trailer	30			Operators	10	0	0.00 0.25
p. car con our or resp nous of the	•	30		Crane Operator	20	0	0.00 0.13
g. Disengage Crane and Yake	10			Operators	. 2	0	0.00 0.04
		10	1	Rogman	10	0	0.00 0.04
		10		Crane Operator	20	0	0.00 0.04
q1. Close Prep Room Door, simultaneous	5			Operator	0	- 0	0.00 0.02
r, Install Trunnian Blocks	20			Operators	20	0	0.00 0.17
		20	1 1	Crane Operator		-	
				Danielan Danielan			
s. HP Survey	20	20		Rediction Protection	2	- 8	0.00 0.17
s. HP Survey 1. Install Teclowine		20 60	2	Operators	2	0	0.00 0.50
		20 60 60	2			0	

Table A1-5. MRS-Reference (continued)

	[- 60		Crane Operator	<u> 20</u>	- 8	0.00	0.2
Install Personnel Barrier	60	60		Operators	-2	- 0	0.00	0.2
		80		Crone Operator	20	ᇷ	100	0.0
Hitch Site Prime Mover	5	5		Prime Mover Operator	15	岢	0.00	
Open Receiving and Shipping Boy Door	5	5		Operator	岢	- 3	0.00	0.0
Precine Shipping Poliperwork	10	10		Operator	_	8	0.00	0.0
Move Cask to Protected Area Gate	10	10		Prime Mover Operator			- 000	0.0
a. Unhitch Site Prime Mover	10	5	1	Prime Mover Operator	-12	- 4		6.6
id	610	1,106						9.0
	!						}	
Prep Ball Transportation Cask								_
horn SNF Transfer Civil to Ship				assume arane enclosus	<u> </u>	0	0.00	0.0
From Cell, Install Coak Shield Plug	25	0		Remote	- 6	히	0.00	0.0
Replace Port Plug	10	0		Remote	-		0.00	0.0
Urmate Cask from Port	10	0		Remote	- 6	- 3	- 0.00	0.0
L Open Transfer Staffun Door	6	0		Operator	10	8.7	435	0.1
Move Cask Into Cask Prep Room	30	30		Operator			50.00	0.2
IPS.Ney	60	30		Radiation Protection	2	60	40.00	0.1
Remove Ud Handling Device	25	20		Operators	2	8.7	125	0.0
		10		Ragman	10	0.5	0.08	0.0
		10		Crane Operator	20		0.00	0.0
g1. Close Transfer Station Door, simultaneous]	0		Operator	0	- 40		0.2
Secure Cosk Bolled Lid	30	30		Operators	2	60	10.00	0.0
Cornect Evacuation/Inerling Equipment	10	10		Operator	_2	37	6.17	0.0
Evacuate and Inert Cask	45	10		Operator	2	8.7	6.53	0.1
		45		Operator	10		5.00	0.0
Disconnect Evacuation/Inerting Equipment	- 5	5		Operator	2	60		0.0
Onen Pren Area Coor	15	0		Operator	- 9	20	0.00	
m. Move On-Site PM and Transporter to Prep Area	10	10		Prime Mover Operator	15	0.5	0.08	0.0
. Untitch Crostie PM	.5	5		Prime Mover Operator	15			
b. Engage Yake to Casik	10	30	1	Operator	_2	17	283	0.0
o. Brocce four to von	10	10		Rogman	10	_	1.45	0.0
		10	1	Crane Operator	20		0.08	0.0
o1. Close Pool Prep Area Door, striuffaneous		0	1	Operator	. 0		0.00	0.0
61. Close Food Press Aved Cook, as included	45	45	2	Operators	10	_	2.70	
p. Place Calk on Trynsporter		45	1	Crane Operator	20		0.38	0.1
1000	45	20	2	Radiation Protection	2		28.67	0.1
c. Perform Release HP Survey	90			Operators	2	32	96.00	2
r. Install Calk Restraints		90		Crane Operator	20			0.3
	90			Operators	2			
s. Install Impact Limiters :		×		Crone Operator	20	0.5		
	30			Operators	2			
t. Indol Personnel Borrier		3		Crane Operator	20	0.5		
	10			Operator	. 0			
LL Prepare Shipping Papers	<u>-</u>			Operator	0	0		0.0
v. Open Prep Area Door	}		5	Prime Mover Operato	r 15	0.5		
w. Hich On-Sie Prime Mover	30			Pirne Mover Operato	r. 15			
x Move Cask to Protected Area Gate(null backgrouns) does		_		Security Officers	2			0.0
y. Perform Security Check				Prime Mover Operate	1 15	0.5	0.04	0.0
z Unhtich On-Site Prime Mover			5	Prime Mover Operato	15	0.5		
CO. Hich Off-Site Prime Mover	6414	_	_		+	I	443	
Total	=	1-	4-			Τ		<u> </u>
		+	+	 	1	Γ		L
7. Prep Slorage Cask from		1-	+-	asume rull backgrou	nd in	itically		
Storage to SNF Tecinster Cell for Unloading	454	2	₹ .	2 Operators	10	8.7		0.
a. Get Transport from Transfer Facility			5	I fransporter Operator	15	0.5		0
	-		5	Rodotion Protection	10	8.7		0
			- 1		: 10	0 6.7	0.73	0.
			5	HIMCHIGUE		2 59	59.00	2
				1 Rogman	- 2			2
b. Remove Storage Cask from Pad		0 3	ol -	2 Operators		5 0.5		3 1.
(Casame SFS background dose)		0 3	0	2 Operators 1 Transporter Operator				
(cosume SFS bookgriund dose)		0 3	0	2 Operators 1 Transporter Operator 1 Radiotion Protection	11		_	<u>' </u>
(cosume SFS bookgilund dose)		0 3	0	2 Operators 1 Transporter Operator 1 Radiation Protection 2 Operators	11	0 8.7	19.67	0.
(cosume SRS bookgrund dose) c. Secure Cask to Transporter	2	0 3	0	2 Operators 1 Transporter Operator 1 Radiation Protection 2 Operators 1 Transporter Operator	10	0 8.7 2 54 5 0.5	19.67	0.
(casume SRSI backgrund dose) c. Secure Cask to Iransporter	2	0 3	0	2 Operators 1 Transporter Operator 1 Radiation Protection 2 Operators 1 Transporter Operator 1 Radiation Protection	1(0 8.7 2 54 5 0.5	19.67 5 0.17 7 1.45 7 8.70) a
c. Secure Cask to Transporter d Masse Cask to Studing Area(rull backgd while move)	. 2	0 3	0	2 Operators 1 Transporter Operator 1 Radiation Protection 2 Operators 1 Transporter Operator 1 Radiation Protection 2 Operators	1! 1(1)	0 8.7 2 54 5 0.8 0 8.7	19.67 0.17 1.45 7 8.70 0 0.00	0 0 0
c. Secure Cask to Transporter d. Move Cask to Staging Areafruil backgd while move) a Cash Sorace Cask frep Room Door	, 2	0 3	0	2 Operators 1 Transporter Operators 1 Rodiction Protection 2 Operators 1 Transporter Operators 1 Rodiction Protection 2 Operators 1 Operators	1(1(1) 1(1)	0 8.7 2 54 5 0.5 0 8.7 0 8.7	19.67 9 0.17 1.45 9 0.70	0 0 0 0 0 0 0
c. Secure Calk to Transporter d. Move Calk to Staging Area(null backgd white move) e. Open Storage Calk Prep Room Door f. Move Call to Storage Calk Prep Area	, 2	0 3 6 3 0 1 2 0 3 5	0	2 Operators 1 Transporter Operator 1 Rodiation Protection 2 Operators 1 Transporter Operator 1 Rodiation Protection 2 Operators 1 Operators 1 Operators	19 19 19 10 10	0 8.7 2 54 5 0.5 0 8.7 0 8.7	19.67 0.17 1.44 7 8.76 0 0.00 7 4.33 5 0.2	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
c. Secure Cask to Transporter d. Move Cask to Straing Areafruil backgd while move) e. Open Storage Cask Prep Room Door 1. Move Cask to Storage Cask Prep Area (ross me crone enclosure background)	. 2	0 3	0	2 Operators 1 Transporter Operators 1 Transporter Operators 2 Operators 1 Transporter Operators 1 Transporter Operators 1 Operators 1 Operators 1 Operators 1 Operators 1 Transporter Operators 1 Operators 1 Transporter Operators 1 Transporter Operators	1! 1 1: 2 1: 3 1: 1 1: 1 1:	0 8.7 2 54 5 0.5 0 8.7 0 8.7 0 0 8.7 5 0.5	19.62 0.12 7 1.42 7 8.76 0.00 7 4.32 5 0.22 0 0.00	
c. Secure Cask to Transporter d. Move Cask to Staging Areatous backgd white move) e. Open Storage Cask Prep Room Door f. Move Cask to Storage Cask Prep Area (assume crane enclosure background) a. Close Storage Cask Prep Room Door	3	0 3 6 3 0 1 5 5	000000000000000000000000000000000000000	2 Operators 1 Transporter Operator 1 Radiation Protection 2 Operators 1 Transporter Operator 1 Radiation Protection 2 Operators 1 Operators 1 Operator 1 Transporter Operator 1 Transporter Operator 1 Operator	11 11 11	0 8.7 2 54 5 0.5 0 8.7 0 8.7 0 0 8.7 5 0.5	7 1.45 7 0.77 9 0.77 0 0.00 7 4.35 0 0.00 9 39.3	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
c. Secure Cask to Transporter d. Move Cask to Staging Areatrual backgd while move) e. Open Storage Cask Prep Room Door f. Move Cask to Storage Cask Prep Area (losume crans enclosure background) g. Close Storage Cask Prep Room Door h. Unsecure Cask from Transporter	3	0 3 6 3 0 1 2 0 3 5 0 3 5	000000000000000000000000000000000000000	2 Operators 1 Transporter Operators 1 Rodotton Protection 2 Operators 1 Transporter Operators 1 Rodotton Protection 2 Operators 1 Operators 1 Operator 1 Innsporter Operator 1 Innsporter Operator 1 Operator 2 Operator	10 10 10 10 10 10	0 8.7 22 56 5 0.5 0 8.7 0 8.7 0 8.7 5 0.5 0 (0 2 2 56 2 56	9 19.6 9 0.1 9 1.4 9 0.0 9 0.0 9 39.3 9 59.0	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0
c. Secure Cask to Transporter d. Move Cask to Staging Areafruil backgd while move) e. Open Storage Cask Prep Room Door f. Move Cask to Storage Cask Prep Area (assume crane enclosure background) g. Case Storage Cask Prep Room Door h. Unsecure Cask from Transporter i. HP Survey Cask	6	0 3 3 0 1 0 3 5 0 3 5 0 3	000000000000000000000000000000000000000	2 Operators 1 Transporter Operators 1 Radiation Protection 2 Operators 1 Radiation Protection 2 Operators 1 Operators 1 Operator 1 Innsporter Operator 1 Innsporter Operator 1 Innsporter Operator 1 Operator 2 Operator 2 Operator 2 Operator 2 Radiation Protection	11 11 11 11 11 11 11 11 11 11 11 11 11	0 8.7 22 56 5 0.5 0 8.7 0 8.7 0 8.7 5 0.5 0 (0 2 2 56 2 56	7 1.4 7 9.7 9 0.0 7 4.3 5 0.2 0 0.0 9 39.3	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0
c. Secure Cask to Transporter d. Move Cask to Staging Areatrual backgd while move) e. Open Storage Cask Prep Room Door f. Move Cask to Storage Cask Prep Area (losume crans enclosure background) g. Close Storage Cask Prep Room Door h. Unsecure Cask from Transporter	3	0 3 3 0 1 0 3 5 0 3 5 0 3 0 3	000000000000000000000000000000000000000	2 Operators 1 Transporter Operators 1 Radiation Protection 2 Operators 1 Transporter Operators 1 Radiation Protection 2 Operators 1 Operators 1 Operator 1 Transporter Operator 1 Operator 2 Operator 2 Operator 2 Operator 2 Radiation Protection 1 Operator	14 14 14 14 14 14	0 8.7 22 54 5 0.5 0 8.7 0 8.7 0 0 0 0 8.7 0	9 19.65 3 0.12 7 1.45 7 8.76 9 0.00 7 4.33 5 0.22 5 0.20 9 39.3 9 59.00 7 194.0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
c. Secure Cask to Transporter d. Move Cask to Staging Areafruil backgd while move) e. Open Storage Cask Prep Room Door f. Move Cask to Storage Cask Prep Area (assume crane enclosure background) g. Case Storage Cask Prep Room Door h. Unsecure Cask from Transporter i. HP Survey Cask	6	0 3 3 0 1 0 3 5 0 3 5 0 3 0 3	000000000000000000000000000000000000000	2 Operators 1 Transporter Operator 1 Radiation Protection 2 Operators 1 Transporter Operator 1 Radiation Protection 2 Operators 1 Operator 1 Operator 1 Transporter Operator 1 Operator 2 Operator 2 Operator 1 Transporter Operator 2 Operator 2 Operator 2 Radiation Protection 1 Operator	10 10 10 10 10 10 10 10 10 10 10 10 10 1	0 8.7 2 565 5 0.5 0 8.7 0 8.7 0 0 0 0 8.7 0 0 0 2 55 2 56 2 97 10 8.7	9 19.65 0.12 7 1.45 7 8.76 0 0.00 7 4.33 5 0.22 0 0.00 0 39.33 0 59.00 7 194.00 7 2.9	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
c. Secure Cask to Transporter d. Move Cask to Staging Areatous backgd white move) e. Open Storage Cask Prep Room Door f. Move Cask to Stagge Cask Prep Area (assume crane enclosure background) g. Close Storage Cask Prep Room Door h. Unsecure Cask from Transporter i. HP Survey Cask j. Remove Storage Cask Ud	2 2 6 6	0 3 0 1 0 3 5 0 3 5 0 3 5 0 3	000000000000000000000000000000000000000	2 Operators 1 Transporter Operators 1 Radiotion Protection 2 Operators 1 Radiotion Protection 2 Operators 1 Coperators 1 Operators 1 Operators 1 Operators 1 Operator 1 Transporter Operator 1 Operator 2 Operators 2 Operators 2 Radiotion Protection 1 Operator 1 Operator 1 Ragman 1 Operator	11 11 12 2	0 8.7 2 565 5 0.5 0 8.7 0 8.7 0 0 0 0 8.7 0 0 0 2 55 2 57 2 97 10 8.7	7 19.65 0.12 7 1.45 7 8.77 8.77 9.77 4.33 5 0.22 5 0.20 0 0.00 7 4.33 7 4.33 7 9 39.33 7 194.00 7 2.95 5 0.1	7 0. 6 0. 0 0. 5 0. 5 0. 6 0. 7 0
c. Secure Cask to Transporter d. Move Cask to Staging Areatous backgd while move) e. Open Storage Cask Prep Room Door f. Move Cask to Storage Cask Prep Area (assume crane enclosure background) g. Close Storage Cask Prep Room Door h. Unsecure Cask from Transporter i. HP Survey Cask j. Remove Storage Cask to Carrier k. Move Storage Cask to Carrier	2 2 6	0 3 3 0 1 0 3 5 0 3 5 0 3 5 0 3	00 00 00 00 00 00 00 00 00 00 00 00 00	2 Operators 1 Transporter Operators 1 Rodiction Protection 2 Operators 1 Rodiction Protection 2 Operators 1 Rodiction Protection 2 Operators 1 Operators 1 Operator 1 Transporter Operator 1 Transporter Operator 2 Operators 2 Rodiction Protection 1 Operator 1 Operators 2 Rodiction Protection 1 Operator 1 Rogman 1 Crans Operator 2 Operators	19 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 8.7 2 59 5 0.5 0 8.7 0 8.7 0 6 8.7 0 0 6.7 5 0.5 0 0 6.7 2 59 2 9 9 0.5 10 8.7	19.65 0.12 7 1.43 7 8.70 0 0.00 7 4.33 5 0.22 0 0.00 9 39.3 9 59.0 7 194.0 7 2.9 5 0.1 8 0.6	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
c. Secure Cask to Transporter d. Move Cask to Staging Area(null backgd while move) e. Open Storage Cask Prep Room Door 1. Move Cask to Storage Cask Prep Area (assure case enclosure background) g. Close Storage Cask Prep Room Door h. Unsecure Cask from Transporter i. HP Survey Cask j. Remove Storage Cask to Carrier k. Move Storage Cask to Carrier	2 2 4 18	0 3 0 1 0 3 5 0 3 5 0 3 5 0 3 6 0 1	00 00 00 00 00 00 00 00 00 00 00 00 00	2 Operators 1 Transporter Operators 1 Rodotton Protection 2 Operators 1 Rodotton Protection 2 Operators 1 Coperators 1 Operators 1 Operator 1 Transporter Operator 1 Operator 2 Operators 2 Operators 2 Operators 2 Rodotton Protection 1 Operator 1 Operator 1 Operator 2 Operators 1 Rogman 1 Crane Operator 2 Operators	19 10 10 10 10 10 10 10 10 10 10 10 10 10	0 8.7 2 59 5 0.5 0 8.7 0 8.7 0 6.7 0 6.7 5 0.5 0 (0 8.7 2 59 2 9 10 8.7 2 9 10 8.7 2 9 10 8.7 2 9 10 8.7 2 9 10 8.7 2 9 3 0 9 4 9 5 0 9 6 9 7 9 8	19.65 0.12 7 1.43 7 8.70 0 0.00 7 4.33 5 0.22 0 0.00 7 9 39.3 9 59.0 7 194.0 7 2.9 5 0.1 8 0.6 5 0.0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
c. Secure Cask to Transporter d. Move Cask to Strigling Area(null backgd white move) e. Open Storage Crisk Prep Room Door 1. Move Cask to Storage Cask Prep Area (assume crane enclosure background) g. Close Storage Cask Prep Room Door h. Unsecure Cask from Transporter i. HP Survey Cask j. Remove Storage Cask Ltd k. Move Storage Cask to Carrier	2 2 4 18	0 3 6 4 3 3 0 1 1 1 0 3 5 5 0 3 5 6 0 1 0 1 0 1	00 00 00 00 00 00 00 00 00 00 00 00 00	2 Operators 1 Transporter Operators 1 Rodiction Protection 2 Operators 1 Rodiction Protection 2 Operators 1 Rodiction Protection 2 Operators 1 Operators 1 Operator 1 Transporter Operator 1 Transporter Operator 2 Operators 2 Rodiction Protection 1 Operator 1 Operators 2 Rodiction Protection 1 Operator 1 Rogman 1 Crans Operator 2 Operators	110 110 110 110 110 110 110 110 110 110	0 8.7 2 59 5 0.5 0 8.7 0 8.7 0 6 8.7 0 0 6.7 5 0.5 0 0 6.7 2 59 2 9 9 0.5 10 8.7	19.65 19.65 1.42 1.43	0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0

Table A1-5. MRS-Reference (continued)

	20	20	1	Crone Operator	20	0.5	0.17	0.08
m 1. Close SNF Transport Cask Prep Room Door							0.00	0.00
simultaneoutly with y			1	Operator	0	0	0.00	0.00
n. Setup Remote Cutting Edulpment	- 45	45		Welder	2	97	72.75	0.19
o. Cut Storage Cask Outer Ltd	. 600	0		Remote	0	0	0.00	0.00
	20	20		Welder	2	97	32.33	0.06
p. Remove Remote Cutting Equipment	30	30		Operator	2	97	48.50	0.13
q. Remove Storage Cask Outer Ud		30		Ragman	10	8.7	4.35	0.13
		30		Crane Operator	26	0.5	0.25	0.13
Attack Control (order Norther No.	. 10	10		Operator	2	97	16.17	0.04
r. Attach Gas Sampling/Venling Rig	10	5		Operator	3	53	4.62	0.02
s Sample Gas Cavilly	10	5		Operator	3	53	442	0.02
t. Vent Cark Covity	10	10		Operator	2	97	16.17	0.04
u. Remove Sampling/Venling Rig	90	80		Coerctors	2		258.67	0.67
v. Loosen Cosk Lid Bolts	25	25		Operators	2	97	80.83	0.21
w. Install Lid Handling Device	30	30		Operators	-3	97		
x. Attach Interface Ridure	10	10		Operator	- 61	8.7	1.45	0.04
y, Remove Plotform	5	- 6		Operators	히	0	0.00	0.00
z. Operators Clear Prep Room	5	- 6		Remote	히		0.00	0.00
aci. Move Cask Under Cell Port	30	0		Remote	히	0	0.00	0.00
bb. Mate Cask to Part	30	- 0		Remote	o	0	0.00	0.00
cc. Open Port and Remove Cask Lid		60		Transporter Operator	15	0.5	0.50	0.25
		30		Radiation Protection	10	8.7	435	
	1620	1.060		ROGORGIFTORCON			1.063	11
Total	1620	1,000						
		}						
8. Receive and Prep Loaded Rail Cask/canister				cesume ruf backgroun	- 			
for Marshalling and Reshipping (Flow-Through)	10		- 1	Operator	၂		0.0	0.0
a. Inspect Bis of Lading, Other Shipping Papers	5	5		Prime Mover Operator		0.5	0.0	0.0
b. Pull Coak Into Security Area	40	30		Security Officers	2	17	17.0	0.0
c. Security inspection		10		Radiation Protection	2	43	143	0.0
d. Perform HP Survey of Cask Edemois and Trailer	30	10		Prime Mover Operator:	15	0.5	0.1	0.0
e. Take Cask to Protected Area	! 10				뜅	0.5	0.1	0.0
1. Unhitch Oti-Stie Prime Mover	10	10		Prime Mover Operator	15	0.5	0.1	0.0
g. Hitch Ste Prime Mover	. 10	10		Prime Mover Operator	15	0.5	0.1	0.0
h. Move Cask to Protected Area Gate	30	30		Prime Mover Operator			0.0	- 6.6
i. Prepare Shipping Paperwork	20	0		Security Officers	0	0.5	0.0	0.0
J. Un-hitch On-Site Prime Mover	5	5		Prime Mover Operator	15	0.5	0.0	0.0
k. Hitch Off-Site Pilme Mover	. 5	5		Prime Mover Operator	15	0.5	32.0	0.0
Total	1 176	115		<u></u>	1	لسب	32.0	<u> </u>

Table A1-6. MRS-TSC

				T				_
otal Doses per Cask Hundling for ISC at the MIS	Direct	Blood	aur.	Roll internativ		Book	bound	-
Revised 20 May 94/HMB	3000		30:	Lid doses		nven		
to a second second	28	_	431	imer	97	area		1
ransfer Rail TSC Into MIS Storage	-23	ا		cuter .	_	aan		_
Step - (1) and that ISC for Storage, from truck SPS cook				Tp/fix contribut	_	deco		1
Steps - (2,3,4)	784	14	796	Lateral Sidn	_	pool	3	1
344-622				Storage cask meen/hr		618	2	
oad flait ISC for Itali shipping, from truck SPS casks		<u> </u>	_	Lid doses				
	1,149	4	1,193		220	7.0	0	1
Steps - (2,3,5)	1,047		1,170	outer	97	_		1-
Cel Rail ISC from MRS Slorage & ship				to/fix conkilled	70			1
	466	- 45	530	Lateral Sidn	70	_		1
Step - (6)					Ť			_
The state of the s								
icil Flow Through (correputed on MRS-RDS flow sheet) and flow through is the same for all technologies.						:		\vdash
CE SON STOUDIES SE COSTO DE CONTROL DE CONTROL						Ť T		
						ļ ļ		
			l I) i				ł
			\$!		1
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			. 2			اہ ا	5	(
			₽ ₽		2	Į	Ę	:
			₽		3	E	8	(
	3		୍ର ହ	}	¥	' }	5	i '
	Total Task Time (Min.)	ہ ا	Personnel Requirect(Persons (Tcalc)		Working Dirtances(Feet)	Cork Dose Rote(mem/hr)	Dose Received(Percriment)	
		Dose fime(Min.)	Į Ž	ا۔	5	. 2	Ĭ	
		Š	ĕ	· <u>S</u>	暑	. •	*	1
	Ī	Ē	2	1	2	×Σ	Ž	۱ ۱
	1	-	5	· **	\$		•	[1
	불	8	\$	Occupation	₹	į Ŗ	⋝	
Cask Handling Operations				assume null backgroun				
I. Receive and Prep ISC for Storage					0			0.0
a. Inspect tills of Lading, Other Shipping Papers	10			Operator				
b. Rull Cask into Security Area		5	_	Pirne Mover Operator	15		0.04	
c. Security Impection	40	30		Security Officers	2		17.00	_
d. Perform HP Survey of Cask Edernals and Trailer	30	10		Radiation Protection	2		14.33	
e. Take Cask to Protected Area	10	10		Prime Mover Operator			0.08	
f. Unhitch Off-Site Prime Mover	10	10		Prime Mover Operator			0.08	
g. Hitch Sile Pitme Mover	10	10	1	Prime Mover Operator			0.08	
h. Take Cask to Receiving and Shipping Bay Door	10	10	3	Prime Mover Operator	15		0.06	
NL Open Receiving and Shipping Bay Door, simultaneous		0	7	Operator	0			
L Take Cask into Receiving and Shipping Bay	5	5		Prime Mover Operator	15		_	
		5		Ragman	10			
Unhitch Site Prime Mover	10	10	1	Pirme Mover Operator	15			
J. Close Receiving and Shipping Bay Door, simultaneous		0	1	Operator	0			
k. Remove Personnel Barrier	25	25	2	Operators	2			
(casame crane crea background dose)		25	1	Crane Operator	8	0.5		
HP Survey	25	10	2	Radiation Protection	2	43		
m. Remove impact Limiters	90	90	2	Operators	3			
		90	1	Crane Operator	20			
n. Remove Tiedowns	50	50		Operators	2			
		50		Crane Operator	8			
o. Remove Trumion Blocks	10	10	2	Operations	٦			
		10		Crane Operation	8			
p. Attach Crane to Yake	5	5	1	Operators	2			0.0
		5		Ragman	10	_		
		5		Crane Operator	20			
q. Engage Yake to Cask	5	5		Operators	2			0.0
facme as MRS-MPC to this point)		5		Ragman	2			
		5	l i	Crane Operator	8	_		
r. Open Prep Room Door	5			Operator	0			0.0
Move Cask into Cask Prep Room Washdown Area	10			Operators	10			0.0
		10		Crane Operator	20	0.5		O.
s1, tratal Platform	10	10		Operator	6	8.7		0.0
al 1. Close SNF Transport Cask Prep Room Door, simultaneou		0		Operator	0): Q		O.C
2. Washdown Cask	30	30	2	Operators	1	17		O.
s3.HP Survey	35			Radiation Protection	2			0.0
st. Remove Pictform	10			Operator	6	8.7		0.0
s5, Move Transport Cask to Carrier	10			Operators	10	1.8		0.0
AND THE SECTION OF THE PARTY OF	T	10		Crone Operator	20	0.5		0.0
só. Place Transport Cask on Carrier	30			Operators	10	. 8.7	8.7	0.
EL FILLY HO BLAST CLER AT COURSE	1	30		Crane Operator	20			0.
	20			Operators		59		
-2 Com as Combine Company		10		Operator		17		0.0
s7. Secure Cask to Carter	1	. 10			10			a
s7. Secure Cask to Canter 8. Disengage Crane with Yoke from Cask, simultaneously	 	10						
s7, Secure Cask to Carrier 8. Disengage Crane with Yoke from Cask, smultaneously		10		Rogman Constant		05	01	i n
Disengage Crane with Yoke from Cask, simultaneously		10		Crane Operator	20			0.0
37. Secure Cask to Carrier 8. Disengage Crane with Yoke from Cask, simultaneously 1. Move Cask to Storage Yard	60	10	1 2			. 8.7	8.70	O.

		- 401		Radiolion Protection	10: 8.7	4.35	0.00
	10	30 10		Operators	2' 59	19.67	_
u. Unsecure Cosk from Transporter	- 10	10		Transporter Operator	15: 0.5		0.33
casume ISFSI background dose)	 	10		Radiation Protection	10: 8.7	1.45	0.33
	60	30		Operators	2 59	59.00	2.00
v. Place Storage Cask on Pad	 ~~	60	-1	Transporter Operator	15 0.5		2.00
	 	30		Radiation Protection	10: 8.7		1.00
Toronto Coolin	50	25		Operators	10 0		0.00
w. Return UnloadedTransport to Transfer Facility	 	25		Transporter Operator	15 0		0.00
null background dose while moving)	1	25	1	Radiation Protection	10 0		0.00
	490	1065				420	10
lotal							
2. Receive and Prep Empty TSC for Loading				casume rull backgrour	rd dose		
a. Impact Bills of Loding, Other Shipping Papers	10	10	1	Operator	0 0		
b. Put Cosk into Security Area	5	5	1	Prime Mover Operator			0.00
- Committee Instruction	30	30		Security Officers	2 0		0.00
d. Perform HP Survey of Cask Edemais and Trailer	30	30		Radiation Protection	2 0		0.00
e. Take Cask to Protected Area	10	10		Prime Mover Operator			88
Unhitch Off-Ste Prime Mover	10	10		Prime Mover Operator			0.00
C. Hitch Site Prime Mover	10	10		Prime Mover Operator			0.00
h. Take Cask to Receiving and Shipping Bay Door	10	10	1	Prime Mover Operator	15, 0		0.00
h1. Open Receiving and Shipping Bay	↓				0 0		0.00
Door, simultaneoutly	1	0		Operator			6.60
i. Take Cask into Receiving and Shipping Bay	5	5		Prime Mover Operator	10: 0		0.00
	┵	5		Rogman			0.00
j. Urrhitch Ste Prime Mover	10	10	 '	Pitrie Mover Operator	1 - S		0.00
ji. Close Receiving and Shipping Bay	↓ 			Coorde	0: 0		0.00
Door, simultaneously	 	0		Operator	3: 0		0.42
k Remove Tiedowns	50	50		Operators	3: 0		0.08
1 Remove Trumion Blocks	10	10		Operators Crane Operator	20 0		0.04
(creame enclosure background dose)	↓ {	10		CIG S CPSGG	 		0.00
11. Open SNF Transport Cask Prep Room	 	ō	 	Operator	0: 0		0.00
Door, simultaneously	┵╾┇	5		Operator	2 0		0.02
m. Attach Crane to Yoke	5	5		Ragman	10 0		0.02
(assume arane enclosure background dose)		5		Crone Operator	20. 0		0.02
	5	5		Operator	2: 0		0.02
n. Engage Yoke to Cask	╃──┦	5		Ragman	10: 0	0.00	0.02
	+	5		Crane Operator	20 0	0.00	0.02
40-10-0	+		 				0.00
Move Cask into SNF Transport Cask Prep Room	30	30	1 - 2	Operators	10 0		0.25
Washdown Area	30	30		Crane Operator	, 20 0	0.00	0.13
	10			Operator	6 0		0.04
p. instal Pictions	30			Operator	2. 0		0.25
q. Woshdown Cosk	35			Radiation Protection	2 0		0.29
I. HP SURVEY	10			Operator	6: 0	4	0.04
Remove Plotform Move Transport Cask to Carrier	10	10	,	Operators	10: 0		0.08
1. Move increport Cast to Comm	1	10) 1	Crane Operator	20 0		
u. Place Transport Cask on Carrier	20	20) [Operators	10 0		0.17
II Mace indisput concerns		20	·	Crane Operator	20 0		0.08
v. Secure Cask to Carrier	20	2		Operator	2 0		0.17
V. STUD CLER IV GUILL	20	20)	1 Crane Operator	20 (0.00
v1. Close SNF Transport Cask Prep	T		1				
Room Door simultaneously				1 Operator	0 0		0 0.02
w. Install Shield Platform	30			i Operator	1 2 5		0 0.75
X. Loosen Cosk Lid Bolls	90			2 Operators			0 0.21
y. Install Ud Handling Device	25			2 Operators			0 0.25
z Attach interface Rature	30			2 Operators	_		0 0.04
pg. Remove Pictform	10			1 Operator			0 0.00
bb. Operators Clear Prep Room				0 Operators			0 0.00
cc. Move Cask Under Cell Port				0 Remote			0 0.00
cirl Mate Cask to Port	30			0 Remote			0 0.00
ee. Open Port and Remove Cask Lid	33			0 Remote	 		0 3.65
Total	670	74	4			1	1
	-}	+	-	assume nuli backgro	und dase	1	
3. Load/Unload SNF (Transfer)	1 2		0	O Remote	0.	0.0	0.00
a. Install a Spacer	1 70			O Remote			0.00
b. Get Bare SNF Grappie	10			0 Remote		0.0	0.00
c. Get and inspect One Bare SNF assembly	1 70			0 Remote	0		0.00
d. Emplace Bare SNF assembly if necessary	1 2			0 Remote	0:		0.00
				DiRemote	0:		0.00
e. Put Bare SNF in Can	1 -					0.0	0.0
f. Install Can Ud		o!	0				i
	10	<u> </u>	0				-
f. Install Can Lid Total		1				 	<u> </u>
f. Install Can Lid Total 4. Prep TSC from SNF Transfer		0		casume crans endo	are bookgr	ound do	>50
f. Install Can Lid Total 4. Prep TSC from SNF Transfer Call for Storage	10		0	ossume crone enclor	1 0.	0 0.0	JU 0.U
f. Install Can Lid Total 4. Prep TSC from SNF Transfer	10	5			0	0 0.0	00 0.00 00 0.00 00 0.00

						2.20
d. Open Transfer Station Door	30	- 0		Operator	0 ₁ 0	0.00 0.00 4.35 0.13
e. Move Cask into Storage Cask Prep Room	46	30		Operator Radiation Protection	2 59	59.00 0.25
f. HP Survey g. Remove Inner Ltd Handing Device	1 25	20		Operators	2 97	64.67 0.17
d removes the to hard growns	 	10		Ragman	10 8.7	1.45 0.04
	+	10		Orane Operator	20 0.5	0.08 0.04
g1. Close Transfer Station Door, simultaneously	+	0		Operator	0 0	0.00 0.00
h. Secure Cosk Bolled Inner Lid	30	30	2	Operators	2 97	97.00 0.25
i, Connect Evacuation/herting Equipment	10	10		Operator	2 97	16.17 0.04
E Evacuate and Inert Cask	46	10	1	Operator	2 37	6.17 0.04
	\mathbf{I}	45	1	Operator	10 8.7	6.53 0.19
tr. Disconnect Evacuation/Inerting Equipment	5	5		Operator	2 97	8.08 0.02
L Place and Seal Weld Valve Cover	90	90		Welder	2: 97	145.50 0.38
m. Place Outer Lid	30	30		Operator	2 60	30.00 0.13
		30		Ragman	10: 8.7	435 0.13
	 	30		Crane Operator	20: 0.5	0.25 0.13
n. Secure Cask Bolled Outer Lid	30	30		Operators	2 60	60.00 0.25
a. HP Survey Coak	60	30		Radiation Protection	2 59	59.00 0.25
p. Open Storage Cosk Prep Room Door	30			Operator	10 8.7	0.00 0.00 4.35 0.13
q. Move Cask to Storage Cask Staging Area	+ 30	30		Operator fra aporter Operator	15 0.5	0.25 0.13
- Charles Carlo Duca Paran Dang	5	30		Operator	0 0	0.00 0.00
r. Close Storage Crark Prep Room Door	10	10		Operators	2 59	19.67 0.08
s. Unsecure Cosk from Carrier 1. Engage Storage Cosk with Transporter	- 60	30		Operators	21 59	59.00 0.25
LOUGH SOUTH THE WALLED BOOK	- 60	30		ironsporter Operator	15 0.5	0.25 0.13
u. Secure Cask to Transporter	20	20		Operators	2 59	39.33 0.17
v. Move Cask to Storage Yard	60	30		Operators	10 8.7	8.70 0.00
(ruil dose background while moving)	 	60		Iransporter Operator	15 0.5	0.50 0.00
0.0000	1	30	1	Radiation Protection	10: 8.7	4.35 0.00
w. Ursecure Cosk from Ironsporter	20	10	2	Operators	21 59	19.67 0.67
(casume EFSI background dose)	1	20	1	iransporter Operator	15: 0.5	0.17 0.67
		10	1	Radiation Protection	10' 8.7	1.45 0.33
x. Place Storage Calk on Pad	60	30		Operators	2: 59	59.00 2.00
		60		Iransporter Operator	151 0.5	0.50 2.00
		30		Radiation Protection	10; 8.7	4.35 1.00
y. Return Unloaded Transport to Transfer Facility	48	25		Operators	10: 0	0.00 0.00
(casume ruil dose while moving)		25		iransporter Operator	15 0	0.00 0.00
	1	25	1	Radiation Protection	10: 0	0.00 0.00
Total	843	945				784 10
	+			assume arane enclosur	a brokerou	~1
5. Prep ISC from SNF Transfer Cell to Ship c. From Cell, Install Coalt Shield Plug	2	0		Remote	0 0	0.00 0.00
b. Replace Port Plug	1 10	o		Remote	0! 0	0.00 0.00
c. Urmate Cask from Part	1 10	o		Remote	0 0	0.00 0.00
d. Open Transfer Station Door	8	0	1	Operator	0 0	0.00 0.00
e. Move Cask into Cask Prep Room	30	30		Operator	10: 8.7	4.35 0.13
1. HP Survey	60			Radiation Protection		
g. Remove Lid Handling Device		30		ROCK CONTROL OF THE PARTY OF TH	21 59	59.00 0.25
	25	20	2	Operators	2. 97	64.67 0.17
		20 10	2 2 1	Operators Ragman	2: 97 10: 8.7	64.67 0.17 1.45 0.04
		20 10 10	2 2 1	Operators Ragmain Crone Operator	2. 97 10: 8.7 20 0.5	64.67 0.17 1.45 0.04 0.06 0.04
g1. Close Transfer Station Door, simultaneous	25	20 10 10	2 2 1 1 1 1	Operators Ragman Crane Operator Operator	2: 97 10: \$.7 20 0.5 0: 0	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00
g1. Close Transfer Station Door, simultaneous h. Secure Cosk Inner Bolled Lid	36	20 10 10 0 30	2 1 1 1	Operators Ragman Crane Operator Operator Operator	2: 97 10: 8.7 20 0.5 0: 0 2: 97	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 97.00 0.25
g1. Close Transfer Station Door, simultaneous h. Secure Cosk Inner Botted Lid k. Connect Evacuation/Institing Equipment	25	20 10 10 0 30	2 2 1 1 2 2	Operators Ragman Crane Operator Operator Operators Operator	2: 97 10: 8.7 20 0.5 0 0 2. 97 2 97	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 97.00 0.25 16.17 0.04
g1. Close Transfer Station Door, simultaneous h. Secure Cosk Inner Bolled Lid	36	20 10 10 0 30 10	2 2 1 1 2 2	Operators Ragman Crane Operator Operator Operators Operator Operator Operator	2. 97 10: 8.7 20 0.5 0 0 2. 97 2 97 2 37	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 97.00 0.25 16.17 0.04 6.17 0.04
g1. Close Transfer Station Door, simultaneous h. Secure Cask Inner Bolled Lid k. Connect Evacuation/Inerling Equipment I. Evacuate and Inert Cask	30 10 45	20 10 10 0 30 10 10 45	2 2 1 1 1 2 1 1	Operators Ragman Crane Operator Operator Operator Operator Operator Operator Operator Operator	2. 97 10: 8.7 20 0.5 0 0 2. 97 2 97 2 37 10 8.7	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 97.00 0.25 16.17 0.04 6.53 0.19
g1. Close Transfer Station Door, simultaneous h. Secure Cask Inner Bolled Lid k. Connect Evacuation/Inerling Equipment L. Evacuate and Inert Cask m. Disconnect Evacuation/Inerling Equipment	30 10 45	20 10 10 0 30 10 10 45 5	2 2 1 1 1 2 1 1 1	Operators Ragman Crane Operator	2. 97 10: \$.7 20 0.5 0 0 2. 97 2. 97 2. 37 10: \$.7 2. 220	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 97.00 0.25 16.17 0.04 6.53 0.19 18.33 0.02
g1. Close Transfer Station Door, simultaneous h. Secure Cask Inner Bolled Lid k. Connect Evacuation/Inerting Equipment L. Evacuate and thert Cask m. Disconnect Evacuation/Inerting Equipment L. Place and Seaf Weld Valve Cover	30 10 45 5	20 10 10 0 30 10 10 45 5	2 2 1 1 1 2 1 1 1 1 1 1	Operators Ragman Crane Operator Weider	2: 97 10: 8.7 20 0.5 0 0 2: 97 2: 97 2: 37 10: 8.7 2: 220 2: 220	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 97.00 0.25 16.17 0.04 6.53 0.19
g1. Close Transfer Station Door, simultaneous h. Secure Cask Inner Botted Lid k. Connect Evacuation/Inerting Equipment L Evacuate and Inert Cask m. Disconnect Evacuation/Inerting Equipment	30 10 45	20 10 10 0 30 10 10 45 5	2 2 1 1 1 2 1 1 1 1 1 1 1 1	Operators Ragman Crane Operator	2: 97 10: 8.7 20 0.5 0 0 2: 97 2: 97 2: 37 10: 8.7 2: 220 2: 220	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 97.00 0.25 16.17 0.04 6.17 0.04 6.53 0.19 18.33 0.02 330.00 0.38
g1. Close Transfer Station Door, simultaneous h. Secure Cask Inner Bolled Lid k. Connect Evacuation/Inerting Equipment L. Evacuate and thert Cask m. Disconnect Evacuation/Inerting Equipment L. Place and Seaf Weld Valve Cover	30 10 45 5	20 10 10 30 10 10 45 5 90	2 2 1 1 2 1 1 1 1 1 1 1 1 1	Operators Ragman Crane Operator Welder Operator	2. 97 10: 8.7 20 0.5 0 0 2. 97 2 97 2 37 10: 8.7 2: 220 2: 220 2, 60	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 97.00 0.25 16.17 0.04 6.33 0.19 18.33 0.02 330.00 0.38 30.00 0.13
g1. Close Transfer Station Door, simultaneous h. Secure Cosk Inner Bolted Lid k. Connect Evacuation/Inerting Equipment L. Evacuatio and Inert Cosk m. Disconnect Evacuation/Inerting Equipment L. Place and Seat Wield Valve Cover L. Place Outer Lid	30 10 45 5	20 10 10 0 30 10 10 45 5 90 30	2 2 1 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1	Operators Ragman Crane Operator	2. 97 10: 8.7 20 0.5 0 0 2. 97 2 97 2: 37 10: 8.7 2: 220 2: 220 2: 60 10: 8.7	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 0.00 0.05 16.17 0.04 6.53 0.19 18.33 0.02 330.00 0.38 34.35 0.13
g1. Close Transfer Station Door, simultaneous h. Secure Cask Inner Bolled Lid k. Connect Evacuation/Inerting Equipment L Evacuate and Inert Cask m. Disconnect Evacuation/Inerting Equipment L Place and Seaf Wield Valve Cover	30 10 45 5 90	20 10 10 30 10 10 10 45 5 90 30 30	2 2 1 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1	Operators Ragman Crane Operator	2: 97 10: 8.7 20 0.5 0 0 2: 97 2: 97 2: 37 10: 8.7 2: 220 2: 220 2: 60 10: 8.7 20: 0.8	64.67 0.17 1.45 0.04 0.08 0.04 0.09 0.00 0.00 0.00 16.17 0.04 6.17 0.04 6.53 0.19 6.53 0.02 330.00 0.38 30.00 0.13 4.35 0.13 0.25 0.13 6.00 0.25 59.00 0.25
g1. Close Transfer Station Door, simultaneous n. Secure Coak Inner Bolted Lid k: Connect Evacuation/tretting Equipment L: Evacuate and Inert Coak m. Disconnect Evacuation/tretting Equipment L: Place and Sed! Wisid Valve Cover L: Place Outer Lid j: Secure Coak Botted outer Lid o. HP Survey Coak n. Open Prep Area Door	25 30 10 45 5 90 30 50 60	20 10 10 30 10 10 45 5 90 30 30 30 30	2 2 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Operators Ragman Crane Operator Ragman Crane Operator Operator Raddotion Protection Operator	2: 97 10: 8.7 20: 0.5 0	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 0.00 0.05 16.17 0.04 6.17 0.04 6.53 0.19 18.33 0.02 30.00 0.38 30.00 0.38 30.00 0.13 4.35 0.13 0.25 0.13 60.00 0.25 0.00 0.00
g1. Close Transfer Station Door, simultaneous h. Secure Coalcinner Bolted Lid k: Connect Evacuation/Inerting Equipment L: Evacuate and Inert Coalc m. Disconnect Evacuation/Inerting Equipment L: Place and Seaf Wield Valve Cover L: Place Outer Lid j: Secure Coalc Bolted outer Lid o. HP Survey Coalc n. Open Prep Area Door o. Move On-Site PM and Transporter to Prep Area	25 30 10 45 90 30 60 5	20 10 10 0 30 10 10 45 5 90 30 30 30 30 30	2 2 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Operators Ragman Crane Operator Ragman Crane Operator	2: 97 10: 8.7 20: 0.5 0	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 0.00 0.00 16.17 0.04 6.53 0.19 18.33 0.02 330.00 0.38 330.00 0.13 4.35 0.13 0.25 0.13 60.00 0.25 59.00 0.25 59.00 0.00
g1. Close Transfer Station Door, simultaneous h. Secure Coalc Inner Bolted Lid k. Connect Evacuation/Inerting Equipment L. Evacuate and Inert Coalc m. Disconnect Evacuation/Inerting Equipment L. Place and Seaf Wield Valve Cover L. Place and Seaf Wield Valve Cover L. Place Outer Lid j. Secure Coalc Bolted outer Lid o. HP Survey Coalc n. Open Prep Area Door o. Move On-Site PM and Transporter to Prep Area p. Unition On-Site PM	30 10 45 90 30 60 60 10	20 10 10 0 30 10 10 10 45 5 90 30 30 30 30 30 10 10 10 10 10 10 10 10 10 10 10 10 10	2 2 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Operators Ragman Crane Operator Ragman Orane Operator Ope	2: 97 10: 8.7 20 0.5 0 0 2: 97 2: 37 10: 8.7 2: 220 2: 220 2: 220 10: 8.7 20: 0.5 2: 60 10: 8.7 20: 0.5 10: 0.5 15: 0.5	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 0.00 0.00 16.17 0.04 6.53 0.19 18.33 0.02 330.00 0.33 4.35 0.13 0.25 0.13 6.00 0.25 59.00 0.25 59.00 0.25 0.00 0.00 0.00 0.00
g1. Close Transfer Station Door, simultaneous h. Secure Coalcinner Bolted Lid k: Connect Evacuation/Inerting Equipment L: Evacuate and Inert Coalc m. Disconnect Evacuation/Inerting Equipment L: Place and Seaf Wield Valve Cover L: Place Outer Lid j: Secure Coalc Bolted outer Lid o. HP Survey Coalc n. Open Prep Area Door o. Move On-Site PM and Transporter to Prep Area	30 10 45 5 90 30 60 5 10	20 10 10 0 30 10 10 10 45 5 90 30 30 30 30 10 10 10 10 10 10 10 10 10 10 10 10 10		Operators Ragman Crane Operator Ragman Crane Operator	2: 97 10: 8.7 20 0.5 0 0 0 2: 97 2: 37 10: 8.7 2: 220 2: 220 2: 400 10: 8.7 20: 0.5 2: 59 0 0 15 0.5 2: 17	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 0.00 0.00 16.17 0.04 6.53 0.19 6.53 0.02 330.00 0.33 30.00 0.33 30.00 0.33 30.00 0.25 59.00 0.25 0.00 0.00 0.04 0.02 2.83 0.04
g1. Close Transfer Station Door, simultaneous h. Secure Coak Inner Bolted Lid k. Connect Evacuation/Inerting Equipment L. Evacuate and Inert Coak m. Disconnect Evacuation/Inerting Equipment L. Place and Seaf Wield Valve Cover L. Place Outer Lid j. Secure Coak Bolted outer Lid o. HP Survey Coak n. Open Prep Area Door o. Move On-Site PM and Transporter to Prep Area p. Unition On-Site PM	30 10 45 90 30 60 60 10	20 10 10 30 10 10 10 45 5 90 30 30 30 30 0 10 10 10 10 10 10 10 45 10 10 10 10 10 10 10 10 10 10 10 10 10		Operators Ragman Crane Operator Ragman Crane Operator Operator Operator Rodolion Protection Operator Prime Mover Operator	2: 97 10: 8.7 20 0.5 0 0 0 2: 97 2: 37 10: 8.7 2: 220 2: 220 2: 400 10: 8.7 20: 0.5 15: 0.5 15: 0.5 17 10: 8.7	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 0.00 0.00 16.17 0.04 6.17 0.04 6.53 0.19 18.33 0.09 330.00 0.38 30.00 0.33 30.00 0.33 30.00 0.25 59.00 0.25 59.00 0.25 0.00 0.00 0.04 0.04 0.04 0.04 1.45 0.04
g1. Close Transfer Station Door, simultaneous h. Secure Coalcinnier Bolled Lid k. Connect Evacuation/tresting Equipment L. Evacuate and trest Coalc m. Disconnect Evacuation/tresting Equipment L. Place and Sed Wield Valve Cover L. Place and Sed Wield Valve Cover L. Place Outer Lid j. Secure Coalc Bottod outer Lid o. HP Survey Coalc n. Open Prep Area Door o. Move On-Site PM and Transporter to Prep Area p. Unflich On-Site PM q. Engage Voice to Coalc	30 10 45 5 90 30 60 5 10	20 10 10 30 10 10 45 5 90 30 30 30 30 30 10 10 10 10 10 10 10 10 10 10 10 10 10	200 200 200 200 200 200 200 200 200 200	Operators Ragman Crane Operator Ragman Crane Operator Operator Prime Mover Operator Operator Prime Mover Operator Operator Ragman Operator	2: 97 10: 8.7 20: 0.5 0	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 0.07,00 0.25 16.17 0.04 6.53 0.19 18.33 0.02 30.00 0.38 30.00 0.38 30.00 0.38 30.00 0.38 30.00 0.39 0.00 0.25 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
g1. Close Transfer Station Door, simultaneous h. Secure Coak Inner Bolted Lid k. Connect Evacuation/Inerling Equipment L. Evacuate and Inert Coak m. Disconnect Evacuation/Inerling Equipment L. Place and Seaf Wield Valve Cover L. Place and Seaf Wield Valve Cover L. Place Outer Lid j. Secure Coak Botted outer Lid o. HP Survey Coak n. Open Prep Area Door o. Move Cn-Site PM and Transporter to Prep Area p. Unitich On-Site PM q. Engage Voice to Coak	30 10 45 90 30 60 5 10 5	20 10 10 30 10 10 45 5 90 30 30 30 30 30 10 10 10 10 10 10 10 10 10 10 10 10 10	213 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Operators Ragman Crane Operator Ragman Crane Operator Operator Prime Mover Operator Prime Mover Operator	2: 97 10: 8.7 20: 0.5 0	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 0.00 6.17 0.04 6.53 0.19 18.33 0.02 330.00 0.38 330.00 0.38 300.00 0.25 59.00 0.25 59.00 0.25 59.00 0.00 0.04 0.02 283 0.04 1.45 0.04 0.04 0.02 283 0.04 0.04 0.02
g1. Close Transfer Station Door, simultaneous h. Secure Coalcinnier Bolled Lid k. Connect Evacuation/tresting Equipment L. Evacuate and trest Coalc m. Disconnect Evacuation/tresting Equipment L. Place and Sed Wield Valve Cover L. Place and Sed Wield Valve Cover L. Place Outer Lid j. Secure Coalc Bottod outer Lid o. HP Survey Coalc n. Open Prep Area Door o. Move On-Site PM and Transporter to Prep Area p. Unflich On-Site PM q. Engage Voice to Coalc	30 10 45 5 90 30 60 5 10	20 10 10 10 30 10 10 45 5 90 30 30 30 30 10 10 10 10 10 10 45 5 90 90 90 90 90 90 90 90 90 90 90 90 90	20 20 20 10 10 10 10 10 10 10 10 10 10 10 10 10	Operators Ragman Crane Operator Ragman Orane Operator Operator Prime Mover Operator Prime Mover Operator	2: 97 10: 8.7 20 0.5 0 0 2: 97 2: 37 10: 8.7 2: 220 2: 220 2: 400 10: 8.7 20: 0.5 2: 50 0 0 15 0.5 15 0.5 17 10: 8.7 20: 0.5	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 0.00 0.00 6.17 0.04 6.53 0.19 18.33 0.02 330.00 0.33 4.35 0.13 0.25 0.13 6.00 0.25 59.00 0.25 59.00 0.25 59.00 0.25 0.00 0.00 0.04 0.02 2.83 0.04 1.45 0.04 0.08 0.04 0.09 0.00 0.00 0.00 0.00 0.00
g1. Close Transfer Station Door, simultaneous h. Secure Cosk Inner Bolled Lid k. Connect Evacuation/Inerting Equipment L. Evacuate and Inert Cosk m. Disconnect Evacuation/Inerting Equipment L. Place and Seal Wisid Valve Cover L. Place Outer Lid j. Secure Cask Bolled outer Lid o. HP Survey Cask n. Open Prep Area Door o. Move On-Site PM and Transporter to Prep Area p. Unition On-Site PM q. Engage Volce to Cask q1. Close Pool Frep Area Door, smultaneous r. Place Cask on Transporter	30 10 45 5 90 30 60 5 10 10	20 10 10 30 10 10 10 45 5 5 90 30 30 30 30 10 10 10 10 45 5 5 90 30 30 10 10 10 10 10 10 10 10 10 10 10 10 10	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Operators Ragman Crane Operator Ragman Crane Operator	2: 97 10: 8.7 20: 0.5 0: 0 2: 97 2: 37 10: 8.7 2: 220 2: 220 2: 400 10: 8.7 20: 0.5 15: 0.5 15: 0.5 17 10: 8.7 20: 0.5 0: 0.5 0: 0.5 0: 0.5 0: 0.5 0: 0.5	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 0.00 0.00 6.17 0.04 6.53 0.19 6.53 0.13 30.00 0.33 30.00 0.33 30.00 0.25 0.03 30.00 0.25 0.00 0.00 0.00 0.00 0.00 0.00 1.45 0.04 0.00 0.00 0.00 0.00 0.00 0.04 0.00 0.00 0.00 0.04 0.00 0.04 0.00 0.04 0.00 0.04 0.00 0.03
g1. Close Transfer Station Door, simultaneous h. Secure Cosk Inner Bolled Lid k. Connect Evacuation/herling Equipment I. Evacuate and Inert Cask m. Disconnect Evacuation/herling Equipment I. Place and Seal Weld Valve Cover I. Place and Seal Weld Valve Cover I. Place Outer Lid j. Secure Cask Botted outer Lid o. HP Survey Cask n. Open Prep Area Door o. Move Christle PM and Transporter to Prep Area p. Unition On-Ste PM q. Engage Volte to Cask q1. Close Pool Prep Area Door, smultaneous r. Place Cask on Transporter s. Perform Release HP Survey	30 10 45 90 30 60 5 10 10 10 10	20 10 10 0 30 10 10 10 45 5 90 30 30 30 30 0 10 10 10 10 45 10 10 10 45 10 10 10 10 10 10 10 10 10 10 10 10 10	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Operators Ragman Crane Operator Ragman Crane Operator Operator Prime Mover Operator Prime Mover Operator Operator Ragman Crane Operator Operator Operator Ragman Orane Operator	2: 97 10: 8.7 20: 0.5 0	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 77.00 0.25 16.17 0.04 6.53 0.19 18.33 0.00 0.38 30.00 0.38 30.00 0.38 30.00 0.25 59.00 0.25 59.00 0.25 0.00 0.00 0.04 0.02 2.83 0.04 1.45 0.04 0.00 0.00 2.83 0.04 1.45 0.04 0.00 0.00 2.83 0.04 1.45 0.04 0.00 0.00 2.83 0.04 1.45 0.06 0.00 0.00 2.83 0.04 1.85 0.04 0.00 0.00 2.83 0.04 1.85 0.04 0.00 0.00 2.83 0.04 0.00 0.00 2.83 0.04 0.00 0.00 2.83 0.04 0.00 0.00 2.83 0.04 0.00 0.00 2.83 0.04 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
g1. Close Transfer Station Door, simultaneous h. Secure Cosk Inner Bolled Lid k. Connect Evacuation/herting Equipment l. Evacuate and Inert Cosk m. Disconnect Evacuation/herting Equipment l. Place and Seaf Weld Valve Cover l. Place Outer Lid j. Secure Cask Bottled outer Lid o. HP Survey Cask n. Open Prep Area Door o. Move On-Site PM and Transporter to Prep Area p. Unitich On-Site PM q. Engage Votes to Cask q1. Close Pool Prep Area Door, smultaneous r. Place Cask on Transporter	30 10 45 5 90 30 60 5 10 10	20 10 10 10 30 10 10 45 5 90 30 30 30 30 30 10 10 10 10 10 45 5 10 10 10 45 5 10 10 10 45 10 10 10 10 10 10 10 10 10 10 10 10 10	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Operators Ragman Crane Operator Ragman Operator	2: 97 10: 8.7 20: 0.5 0: 0 2: 97 2: 37 10: 8.7 2: 220 2: 220 2: 400 10: 8.7 20: 0.5 15: 0.5 15: 0.5 17 10: 8.7 20: 0.5 0: 0.5 0: 0.5 0: 0.5 0: 0.5 0: 0.5	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 0.00 16.17 0.04 6.53 0.19 18.33 0.02 0.38 30.00 0.38 30.00 0.38 30.00 0.25 0.13 4.35 0.13 0.25 0.13 60.00 0.25 0.00 0.00 0.06 0.04 0.04 0.02 2.83 0.04 0.06 0.04 0.06 0.04 0.07 2.83 0.04 0.08 0.04 0.09 0.00
g1. Close Transfer Station Door, simultaneous h. Secure Coald Inner Boffed Lid k. Connect Evacuation/Inerling Equipment L. Evacuate and Inert Coald m. Disconnect Evacuation/Inerling Equipment L. Place and Seal Wield Valve Cover L. Place and Seal Wield Valve Cover L. Place Outer Lid j. Secure Coald Boffed auter Lid o. HP Survey Coald n. Open Prep Area Door o. Move Chistle Pivi and Transporter to Prep Area p. Unition On-Ste Pivi q. Engage Volte to Coald q1. Close Pool Prep Area Door, smultaneous r. Place Coald on Transporter s. Perform Release HP Survey	30 10 45 90 30 60 5 10 10 10 10	20 10 10 0 30 10 10 10 45 5 90 30 30 30 30 0 10 10 10 10 45 10 10 10 45 10 10 10 10 10 10 10 10 10 10 10 10 10	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Operators Ragman Crane Operator Ragman Crane Operator Operator Prime Mover Operator Prime Mover Operator	2: 97 10: 8.7 20: 0.5 0	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 0.00 6.17 0.04 6.53 0.19 18.33 0.02 330.00 0.38 330.00 0.38 330.00 0.25 59.00 0.25 59.00 0.25 59.00 0.26 0.00 0.00 0.00 0.00 2.83 0.04 1.45 0.04 0.00 0.00 2.83 0.04 1.45 0.04 0.00 0.00 2.70 0.38 0.38 0.19 28.67 0.17 0.03 4.7 0.66 2.3
g1. Close Transfer Station Door, simultaneous h. Secure Coald Inner Boffed Lid k. Connect Evacuation/Inerling Equipment L. Evacuate and Inert Coald m. Disconnect Evacuation/Inerling Equipment L. Place and Seal Wield Valve Cover L. Place and Seal Wield Valve Cover L. Place Outer Lid j. Secure Coald Boffed auter Lid o. HP Survey Coald n. Open Prep Area Door o. Move Chistle Pivi and Transporter to Prep Area p. Unition On-Ste Pivi q. Engage Volte to Coald q1. Close Pool Prep Area Door, smultaneous r. Place Coald on Transporter s. Perform Release HP Survey	30 10 45 90 30 60 5 10 10 10 10	20 10 10 30 10 10 45 5 90 30 30 30 30 30 10 10 10 10 10 45 5 5 10 10 10 10 45 5 7 10 10 10 10 10 10 10 10 10 10 10 10 10	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Operators Ragman Crane Operator Ragman Operator	2: 97 10: 8.7 20: 0.5 0	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 0.00 6.17 0.04 6.53 0.19 18.33 0.02 330.00 0.38 30.00 0.38 30.00 0.25 0.03 0.04 0.04 0.02 2.83 0.04 0.04 0.02 2.83 0.04 0.04 0.02 2.83 0.04 0.04 0.02 2.83 0.04 0.04 0.02 2.83 0.04 0.04 0.02 2.83 0.04 0.04 0.02 2.83 0.04 0.04 0.02 2.83 0.04 0.04 0.02 2.83 0.04 0.04 0.02 2.83 0.04 0.04 0.02 2.83 0.04 0.04 0.02 2.83 0.04 0.04 0.02 2.83 0.04 0.05 0.04 0.06 0.04 0.07 0.07 0.08 0.04 0.09 0.00
g1. Close Transfer Station Door, simultaneous h. Secure Cask Inner Bolled Lid k. Connect Evacuation/Inerling Equipment l. Evacuate and Inert Cask m. Disconnect Evacuation/Inerling Equipment l. Place and Seaf Wild Valve Cover l. Place and Seaf Wild Valve Cover l. Place Outer Lid j. Secure Cask Botted outer Lid o. HP Survey Cask n. Open Prep Area Door o. Move On-Site PM and Transporter to Prep Area p. Untrich On-Site PM q. Engage Volte to Cask a1. Close Pool Prep Avea Door, smultaneous r. Place Cask Restrants	30 10 45 90 30 60 5 10 10 10 10	20 10 10 30 10 10 45 5 90 30 30 30 30 0 10 10 10 10 10 45 45 5 90 30 30 30 0 10 10 10 10 10 10 10 10 10 10 10 10	2 2 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Operators Ragman Crane Operator Prime Mover Operator	2: 97 10: 8.7 20: 0.5 0: 0.7 2: 97 2: 37 10: 8.7 2: 220 2: 220 2: 220 2: 60 10: 8.7 20: 0.5 15: 0.5 17 10: 8.7 20: 0.5 2: 17 10: 8.7 20: 0.5 2: 43 2: 43 15: 0.5 20: 0.5	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 0.00 0.00 0.7.00 0.25 16.17 0.04 6.53 0.19 6.53 0.02 330.00 0.33 30.00 0.33 30.00 0.33 30.00 0.33 30.00 0.33 30.00 0.33 4.35 0.13 6.00 0.25 59.00 0.25 0.00 0.00 0.04 0.02 2.83 0.04 1.45 0.04 0.08 0.04 0.08 0.04 0.09 0.00 2.70 0.38 0.39 0.19 2.67 0.17 100.3 4.7 0.6 2.3 0.6 2.3
g1. Close Transfer Station Door, simultaneous h. Secure Cosk Inner Bolled Lid k. Connect Evacuation/Inerling Equipment L. Evacuate and Inert Cosk m. Disconnect Evacuation/Inerling Equipment L. Place and Sed: Wield Valve Cover L. Place and Sed: Wield Valve Cover L. Place Outer Lid j. Secure Cask Bolled auter Lid o. HP survey Cask n. Open Prep Area Door o. Move Cin-Site PM and Transporter to Prep Area p. Unition On-Site PM and Transporter to Prep Area p. Unition On-Site PM q. Engage Valve to Cask q1. Close Pool Prep Area Door, smultaneous r. Place Cask on Transporter	30 10 45 5 90 30 60 5 10 10 10	20 10 10 30 10 10 45 5 90 30 30 30 30 30 10 10 10 10 10 45 5 70 70 70	20 20 20 11 10 10 10 10 10 10 10 10 10 10 10 10	Operators Ragman Crane Operator Ragman Crane Operator Operator Prime Mover Operator Prime Mover Operator Ragman Crane Operator	2: 97 10: 8.7 20: 0.5 0	64.67 0.17 1.45 0.04 0.08 0.04 0.00 0.00 0.00 0.00 16.17 0.04 6.17 0.04 6.53 0.19 6.53 0.19 30.00 0.33 30.00 0.25 59.00 0.25 0.00

Install Personnel Barrier Open Receiving and Shipping Bay Door, simultaneous Hitch Site Prime Mover	35	35 35 35	2	Radiation Protection Operators Perme Mover Operator Crane Operator	10: 8.7 2: 43 15: 0.5 20: 0.5	16.0 50.2 0.34 0.34	
Open Receiving and Shipping Bay Door, simultaneous	35	35 35	1	Pirme Mover Operator	15: 0.5	0.34	1.2
Open Receiving and Shipping Bay Door, simultaneous		35					
Open Receiving and Shipping Bay Door, simultaneous			11	Crone Operator	20 0.5	0.34	
Open Receiving and Shipping Bay Door, simultaneous							1.2
Open Receiving and Shipping Bay Door, simultaneous		35	1	Radiation Protection	10 8.7	5.1	1.2
Open Receiving and srepping day cod, which save	1 -1	0	1	Operator	0, 0	0.0	0.0
1 Little Oto Drime Michiel	10	10		Prime Mover Operator	15 0.5	0.3	0.0
	20	0		Operator	0 0	0.0	0.0
2. Prepare Shipping Papers	10	10		Operators	10' 8.7	29	0.0
3. Move Cask to Protected Area Gate		10		Prime Mover Operator	15 0.5	0.11	0.0
we me roll siding background dose some as crone endo	<u>4170)</u>				20 0.5	0.1	0.0
asume ruil background while moving)		10		Crone Operator	10 8.7	1.5	0.0
		10		Radiation Protection	2 17	2.8	0.0
4. Perform Security check	5	- 5		Security Officers		15	0.0
	5	5		Operators	10 8.7		0.0
		5		Prime Mover Operator	15 0.5	0.0	_
. Make-up with other cask cars per tran (assume 3 cars)	60	60	2	operator-rai	15 1.2	24	0.5
City Of City Dime Mark	5	5	2	Operators	10 8.7	1.5	0.0
Hitch Ott-Site Prime Mover	1	5	11	Prime Mover Operator	15 0.5	0.0	0.0
	925	1590				1,149	40
old	+						
	+			asume ISFSI backgrou	nd dose		
. Peop ISC from ISFSI Storage for Shipping	60	60		Operators	2 60	120.00	4.00
a. Install Cask Closure	1 00	60		Prime Mover Operator	15 0.5	0.50	
	4				20 0.5	0.50	2.00
	4	60		Crane Operator	10: 8.7	8.70	
		. 60	1	Radiation Protection	10: 0/	0.00	
b. Prepare to Move Ott-Site Transportation Cask from	1					17.40	
ISFSI Storage Yard	60	60		Operators	21 8.7		_
B-3300P 100		8		Prime Mover Operator		0.50	
		60		Crane Operator	20 0.5	0.50	2.00
	1	60	1	Radiation Protection	10 8.7	8.70	
The Late of the Control	60	60	2	Operators	10 8.7	17.40	_
c. Perform Shipping HP Survey Cosk	+	60		Prime Mover Operator	15: 0.5	0.50	2.00
	 	60		Crane Operator	20 0.5	0.50	2.00
	 	60		Radiation Protection	2 43	43.00	2.00
	60			Operators	21 43	43.00	200
d. Deconfaminate Calk	┼ —~	60		Prime Mover Operator	15: 0.5	0.50	2.00
		60		Crane Operator	20 0.5	0.50	2.00
·		60		Radiation Protection	10, 8.7	8.70	2.00
					2 32		
e. Install Cosk Restraints	90			Operators			
		60		Prime Mover Operator	20 0.5		
		60		Crane Operator	10 8.7		
		60		Rudiation Protection	2' 32		
f, Install Impact Limiters	90			Operators	100		
1, 4		60		Prime Mover Operator			
		60		Crane Operator	20 0.5		
	1	60		Radiation Protection	10 8.7		_
and Conserved Remote	30	30		Operators	2 32		
g. Install Personnel Barner		30	1	Prime Mover Operator			
	+	30		Crone Operator	20: 0.5		
		30		Radiation Protection	10: 8.7		
	10			Operator	10: 8.7	0.00	
h. Prepare Shipping Papers	 "	1 8	_	Prime Mover Operato	15 0.5	0.00	0.0
		 0		Crane Operator	20: 0.5	0.00	0.0
		 		Radiation Protection	10 8.7	0.00	0.0
					10 8.7		0.6
i. Move Cask to ISFSI Protected Area Gate	10			Operators			0.3
(assume null background dose at gate)		10	_	Prime Mover Operato	20: 0.5		0.3
		10		Crone Operator	10, 8.7		0.3
		10		Radiation Protection			_
L	11			Operators	10: 8.7		0.0
Litherton Con-Ste PM					15 0.5	» uu	0.0
1 Unhitch Ch-Site PM		10		Prime Mover Operato			
	30			Operators	10' 8.7	2.90	0.0
j. Umitich On-Site PM k. Hitch Off-Site PM					10' 8.7	2.90	0.0

Table A1-7. MRS-MPU

The second secon		·		Rc≤ mrem/tr		Booko	or med	
loial Doses per Cast: Handling for MPUs of the	MICS	 		Ud doses	-	Eren/		
Revised 2-June 94/HN/G	Direct	Stod	-	hrer	220	Grea		
Load MPU for Shipping	(person			culer		aane		
Steps - (2.3,4.5,6,8)	1,873		1,145	To/fix contito	70	decon	1	
				Lateral Sán	50	pool	3	
Load MPU for Storago				Storage cask mem/re		ISFSI	2	
Steps - (2.3.4.5.6,7)	1,703	28	1,731	Lid doses	L			
				Irner			0	
Incresier MPU Info Storage				outer .	97			
Stage - (1)	441		4166	Tp/Tx conkild	70			
				Lateral San	-/0			
Transfer MPU from storage for shipping	661	71	(22		├			
Steps - (9)	901		1922		-			
Roll Flow Through of technologies					-			
Shown on MRS-RDS spreadtheet								
S DATO: MICO STOCK								
Cask Handling Operations	fold Took Time(Min.)	Dose fine(Mn.)	Personnel Required(Persons/Totk)	octodion	Working Distances(Feet)	Calk Dose Rote(mem/.ht)	Dose Received(Person-mem)	rem-mach parampan emp ngog
Receive and Prop MPU for		 				-		
Siorage		1		asume ruli backgrour	d do	e Initial	y	
a. Inspect Bills of Lacing, Other Shipping Papers	10	10		Operator	0	0	0.0	
b. Pull Cook into Security Area	5			Prime Mover Operator			0.0	
c. Security impection	40			Security Officers	2		17.0	
d. Perform HP Survey of Cask Externals and Iral	30			Radiation Protection	2		143	0.00
e. Take Cask to Protected Area	10			Prime Mover Operator			0.1	
f. Unhlich Off-Site Prime Mover	10			Prime Mover Operator			0.1	
g. Hitch Ste Prime Mover	10			Prime Mover Operator Prime Mover Operator			0.1	
h. Take Cark to Recisiving and Shipping Bay Do Ni. Open Receiving and Shipping Bay Door, sim		<u> </u>	ينصد سيسا	Operator	- ~			
I. Take Cark into Receiving and Shipping Bay	5		 	Prime Mover Operator				
L 10th COX 110 ACCURAGE OF THE PARTY		5		Rogman	10	8.7	0.7	0.00
L Lintilich Site Prime Mover	10	10		Prime Mover Operator	15	0.5	0.1	
I.Class Receiving and Shipping Bay Door, simu	taneous	0	1	Operator	0			
k. Remove Personnel Borrier	25	25		Operators	_ 2	+	26.7	0.00
		25		Crane Operator	20	_		
L HP SUNNY	25			Radiation Protection	2			
m. Remove impact Limiters and Neutron Shield	90			Operators	1 3			_
	50	90		Crane Operator Operators	20			0.4
n. Remove Tlectowns	30							0.2
o. Remove Trunvion Blocks	10	10		Operators	20	32		
C. DESIGNA OF STATEMENT	† — <u>~</u>	10		Crane Operators	20			0.0
p. Attach Crane to Yake	6			Operators	2	0		
<u> </u>		8			10	0		
				Ragman		0	0.0	_
		5		Crane Operator	20			
a. Engage Yoke to Cask		5	1	Crane Operator Operators	2	17		
a. Engage Yoke to Cask		5 5	1	Crane Operator Operators Rogman	10	17 8.7	0.7	0.0
		5 5		Crane Operator Operators Rogman Crane Operator	10	8.7 0.5	0.7 0.0	0.00
c. Engage Yoke to Cask r. Engage Storage Cask with Transporter	60	5 5 5	1 1 2	Crane Operator Operators Rogman Crane Operator Operators	10 20 20	8.7 0.5 59	0.7 0.0 59.0	0.00
		5 5 5 30	1 1 2	Crane Operator Operators Rogman Crane Operator Operators Radiation Protection	10 20 20	17 8.7 0.5 59	0.7 0.0 59.0 11.0	0.00 0.00 0.20 0.20
r. Engage Storage Cask with Transporter	60	5 5 5 5 30 60		Crane Operator Operators Rogman Crane Operator Operators Roadation Protection Iransporter Operator	20 20 20 21	17 8.7 0.5 59 11	0.7 0.0 59.0 11.0	0.00 0.00 0.20 0.20
		5 5 5 5 60 60		Crane Operator Operators Rogman Crane Operator Operators Radiation Protection	10 20 20	17 8.7 0.5 59 11 0.5	0.7 0.0 59.0 11.0 0.5 39.3	0.00 0.00 0.20 0.20 0.20
r. Engage Storage Cask with Transporter	60	5 5 5 30 60 60		Crane Operator Operators Rogman Crane Operator Operators Roadiotors Roadiotor Protection Transporter Operator Operators	200 200 200 200 200 200 200 200 200 200	17 8.7 0.5 59 11 0.5 59 11 0.5	0.7 0.0 59.0 11.0 0.5 39.3 3.7 0.2	0.00 0.00 0.20 0.20 0.10 0.00
r. Engage Storage Cask with Transporter a. Secure Cask to Transporter	60	5 5 5 30 60 60 20 20 20		Crane Operator Operators Rogman Crane Operator Operators Radiation Protection Transporter Operator Operators Radiation Protection Transporter Operator Operators Radiation Protection Transporter Operator Operators	20 20 22 22 24 25 22 25 15	17 8.7 0.5 59 11 0.5 59 2 11 0.5 8.7	0.7 0.0 59.0 11.0 0.5 39.3 3.7 0.2	0.00 0.02 0.22 0.22 0.11 0.00 0.00
r. Engage Storage Cask with Transporter	20	55 55 55 300 600 600 200 200 200 200 200 200 200 2		Crane Operator Operators Flogman Crane Operator Operators Radiation Protection Transporter Operator Operators Radiation Protection Transporter Operator Operators Transporter Operator Operators Transporter Operator	20 20 22 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	17 8.7 0.5 59 11 0.5 59 11 0.5 10 0.5 0.5	0.7 0.0 59.0 11.0 0.5 39.3 3.7 0.2 8.7	0.00 0.02 0.22 0.12 0.00 0.00 0.02
r. Engage Storage Cask with Transporter s. Secure Cask to Transporter	20	55 55 55 300 600 200 200 200 200 200 300 600 300 300 300 300 300 300 300 3		Crane Operator Operators Flogman Crane Operator Operators Readation Protection Transporter Operator Operators Readation Protection Transporter Operator Operators Transporter Operator Operators Transporter Operator Readation Protection	20 20 22 22 24 25 25 26 16 16 16	17 8.7 0.5 59 11 0.5 59 11 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.7 0.0 59.0 11.0 0.5 39.3 3.7 0.2 8.7 0.5	0.0 0.0 0.2 0.2 0.1 0.0 0.0 0.2 0.2
r. Engage Storage Cask with Transporter s. Secure Cask to Transporter	20	55 55 55 56 60 20 20 20 20 20 20 30 60 60 60 20 20 20 20 20 20 20 20 20 20 20 20 20		Crane Operator Operators Rogman Crane Operator Operators Rodiction Protection Transporter Operator Operators Rodiction Protection Transporter Operator Operators Transporter Operator Operators Transporter Operator Rodiction Protection Rodiction Protection Operators	20 20 22 22 23 25 25 26 26 26 27 26 27 27 27 27 27 27 27 27 27 27 27 27 27	17 8.7 0.5 59 11 0.5 8 9 11 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.7 0.0 59.0 11.0 0.5 39.3 3.7 0.2 8.7 0.5	0.00 0.02 0.22 0.11 0.00 0.02 0.12 0.11 0.00
r. Engage Storage Cask with Transporter a. Secure Cask to Transporter t. Move Cask to Storage Yard	20	5 5 5 5 5 5 60 60 20 20 20 20 30 60 60 20 20 20 20 20 20 20 20 20 20 20 20 20		Crane Operator Operators Flagman Crane Operator Operators Radiation Protection Transporter Operator Operators Radiation Protection Transporter Operator Operators Transporter Operator Radiation Protection Transporter Operator Operators Transporter Operator Radiation Protection Operators Transporter Operator	20 10 20 22 2 2 2 2 2 3 15 16 16 16 16 16 16 16 16 16 16 16 16 16	17 8.7 0.5 59 11 0.5 0.5 11 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.7 0.0 59.0 11.0 0.5 39.3 3.7 0.2 0.5 4.4 19.7	0.00 0.02 0.22 0.23 0.13 0.00 0.00 0.22 0.13 0.00 0.00
r. Engage Storage Cask with Transporter s. Secure Cask to Transporter t. Move Cask to Storage Yard u. Unsecure Cask from Transporter	60	55 55 55 56 60 20 20 20 20 30 30 30 30 30 30 30 30 30 30 30 30 30		Crane Operator Operators Rogman Crane Operator Operators Radiation Protection Transporter Operator Operators Radiation Protection Transporter Operator Operators Transporter Operator Radiation Protection Transporter Operator Radiation Protection Radiation Protection Operators Transporter Operator Radiation Protection Radiation Protection	20 10 20 22 22 23 25 24 15 10 10 15 10 10	17 8.7 0.5 59 11 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.7 0.0 59.0 11.0 0.5 39.3 3.7 0.2 0.5 4.4 19.7	0.00 0.00 0.22 0.23 0.13 0.00 0.00 0.22 0.13 0.00 0.00 0.00
r. Engage Storage Cask with Transporter a. Secure Cask to Transporter 1. Move Cask to Storage Yard	20	\$5 \$5 \$5 \$60 \$60 \$20 \$20 \$30 \$30 \$30 \$30 \$30 \$30 \$30 \$30 \$30 \$3		Crane Operator Operators Flogman Crane Operator Operators Radiation Protection Iransporter Operator Operators Radiation Protection Iransporter Operator Operators Iransporter Operator Radiation Protection Iransporter Operator Radiation Protection Operators Iransporter Operator Radiation Protection Operators Iransporter Operator Radiation Protection Operators	20 20 20 22 22 23 15 10 10 10 10 10 10 10 10 10 10 10 10 10	17 8.7 0.5 59 11 0.5 87 11 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.7 0.0 59.0 11.0 0.5 39.3 3.7 0.2 8.7 0.5 4.4 19.7 0.2 1.5 59.0	0.00 0.22 0.23 0.13 0.00 0.22 0.13 0.00 0.20 0.00 0.00 0.00 0.00 0.00 0.0
r. Engage Storage Cask with Transporter s. Secure Cask to Transporter t. Move Cask to Storage Yard u. Unsecure Cask from Transporter	60	55 55 55 56 60 20 20 20 20 30 30 30 30 30 30 30 30 30 30 30 30 30		Crane Operator Operators Rogman Crane Operator Operators Radiation Protection Transporter Operator Operators Radiation Protection Transporter Operator Operators Transporter Operator Radiation Protection Transporter Operator Radiation Protection Radiation Protection Operators Transporter Operator Radiation Protection Radiation Protection	20 10 20 22 22 23 25 24 15 10 10 15 10 10	17 8.7 0.5 59 11 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.7 0.0 59.0 11.0 0.5 39.3 37.3 3.7 0.2 8.7 0.5 4.4 19.7 5.5 5.0 0.5	0.02 0.25 0.25 0.17 0.00 0.25 0.13 0.00 0.25 0.10 0.00 0.25 0.10 0.00 0.25 0.10 0.00 0.25 0.10 0.00 0.25 0.10 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.2

		25		Iransporter Operator	15	0.5	0.2	0.1
		25	11	Radiation Protection	10	8.7	3.6	0,1
rigi	620	1070					461	
					-		0.00	4.6
Receive Empty MPU (see MPC table Step 2)	200	. •			\dashv		0.00	4,1
Receive Unloaded Universal							0.00	8.
overpack (see MPC table, Step 6)	400					 -	- 0.00	
							0.00	1.
Load MPU into Overpack (see MPC table \$6	180						0.00	- 4.
Prop MPU/Universal overpack for SNF transle	r Cell					0	0.00	-
Indal Policin	10	10		Operator	2	- 8	0.00	-
s. Engage Crane to MPU LIR Attachment	10	10		Operator		- 6	0.00	
		30		Ragman	10		0.00	-
		30		Crone Operator	20	- 0		_
Move MPU Over Storage Cask	10	30		Operators	10	0	0.00	_
		70		Crone Operator	20	0	0.00	_
d. Verify Vertical Alignment of MPU to Storage	10	10		Operator	2	<u> </u>	0.00	_
		10		Roomon	10	0	0.00	-
		10		Crane Operator	20	0	0.00	
Lower MPU into Storage Cask	30	30		Operator	2	0	0.00	
		30		Ragman	10	0	0.00	-
		30		Crane Operator	20	0	0.00	_
g. Disengage MPU Lifting Attachment	10	70		Operator	2	0	0.00	
		10		Ragman	10	0	0.00	
		10		Crane Operator	_20	0	0.00	
h, instal a Spacer	10	10		Operators	2	0	0.00	
(10	1	Crone Operator	20	0	0.00	
L Place MPU Shield Plug	30	30	2	Operators	2	0	0.00	
, PIOCE IN CO. FILE		30	1	Ragman	10	0	0.00	_
		30	1	Crane Operator	20	0	0.00	
. Attach interface Fature	10	10	2	Operators	2	0	0.00	
k. Remove Hatform	10	10	1	Operator	6	0	0.00	
L Move Storage Cask Under Cell Port	30		0	Remote	0	0	0.00	
m. Male Storage Cask to Cell Part	30		0	Remote	0	0	0.00	
n. Remove Part Plug and MPU Shield Plug	15		2	Operators	2	0	0.00	
IT. Remove Part Plug dr. 2 His G d assorting	 	15		Rogman	10	0	0.00	
	 	15		Crane Operator	8	0	0.00	
	215	445					0.00	L
Total	1	1 - 3 - 3						
	1		ck or Em	plocement				
Load SNF into MPU/Transportation- or MPU/	1	overpo	ck or En	nolocement			3.00	
Total i. Load SNF into MPU/Transportation- or MPU/ Total	Storage	overpo	ck or Em					
. Load SNF into MPU/Transportation- or MPU/ Total	Storage	overpo 6		placement	e box	kgrour	d dose	
i. Load SNF into MPU/Transportation- or MPU/ Total 7. Prep MPU/Universal-overpack from SNF fran	Storage - 100	overpo 6	90		• box	kgroun		
Load SNF into MPU/Transportation- or MPU/ Total 7. Prep MPU/Universal-overpack from SNF fran Total	Storage 100 sier cell 1 3,255	overpo e store 1,235	90				d dose 1,703	
Load SNF into MPU/Iransportation- or MPU/ Total Peop MPU/Universal-overpack from SNF fran Total	Storage 100 sier cell 1 3,255	overpo e store 1,235	90		CHALF	ne cara	d dose 1,703	-
Load SNF into MPU/Transportation- or MPU/ Total 7. Prep MPU/Universal-overpack from SNF fran Total	Storage 100 sier cell 1 3,255	overpo e store 1,235	ge ping		20 20	ne crar 0.5	d dose 1,703 ne encios 0,9	
. Load SNF into MPU/Transportation- or MPU/ Total 7. Prep MPU/Universal-overpack from SNF fram	Storage 100 sier cell 1 3,255	overpo 0 0 storo 1,235	ge pring	Casume crone enclosur	20 10	0.5 8.7	d dose 1,703 ne endos 0.9	
Load SNF into MPU/Transportation- or MPU/ Total Prep MPU/Universal-overpack from SNF fran Total Prep MPU/Universal-overpack from SNF fran	Storage 100 sier cell 1 3,255	lo storo 1,235 for Ship 110	pping 1 1 2	crane Operator Radiation Protection Operators	20 10	0.5 8.7 43	1,703 1,703 ne encice 0.9 16.0	250
Load SNF into MPU/Transportation- or MPU/ Total Peop MPU/Universal-overpack from SNF fran Total Peop MPU/Universal-overpack from SNF fran	Storage - 100 ster cell 1 3,255	lo storo 1,235 for Ship 110	ge	crane Operator Radiation Protection Operators Prime Mover Operator	20 10 20	0.5 8.7 43	1,703 1,703 ne endos 0,9 16.0 50.2	
Load SNF into MPU/Transportation- or MPU/ Total 7. Prep MPU/Universal-overpack from SNF fran Total	Storage - 100 ster cell 1 3,255	tor Ship	ping 1 1 2 1 1 1 1 1	Crane Operator Radiation Protection Operators Prime Mover Operator Crane Operator	20 10 2 15 2	0.5 8.7 43 0.5 0.5	0.9 1,703 0.9 16.0 50.2 0.3	
Load SNF into MPU/Transportation- or MPU/ Total Peop MPU/Universal-overpack from SNF fran Total Peop MPU/Universal-overpack from SNF fran	Storage - 100 ster cell 1 3,255	tor Ship 110 110 110 110	ping 1 1 2 1 1 1	crane Operator Radiation Protection Operators Prime Mover Operator	20 10 20 15 15	0.5 8.7 43 0.5 0.5 0.5	d dose 1,703 ne endos 0,9 16.0 50.2 0.3 0.3	
Load SNF into MPU/Transportation- or MPU/Transportation- or MPU/Transportation- or MPU/Transportation- or MPU/Transportation- or MPU/Transportation- sNF fram Total The p MPU/Universal-overpack from SNF fram the property of the property o	Storage 100 steer cell 1 3,255 steer Cell 3 35	overpo 0 1,235 for Ship 110 110 35 35 35	pping 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Crane Operator Radiation Protection Operators Prime Mover Operator Crane Operator Radiation Protection Operator Operator Operator Operator	20 10 20 15 20 10 0	0.5 8.7 43 0.5 0.5 0.5 0.5	d dose 1,703 ne endos 0,9 16.0 50.2 0.3 0.3 5.1	250
Load SNF into MPU/Transportation- or MPU/Tedal 7. Prep MPU/Universal-overpack from SNF frantiotal 8. Prep MPU/Universal-overpack from SNF frantiotal 91. Install Personnel Barrier 101. Coen Receiving and Shipping Bay Door.	Storage 100 steer cell 1 3,255 steer Cell 3 35	0 stores 1,235 10 110 110 35 35 35	pping 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Crane Operator Radiation Protection Operators Prime Mover Operator Crane Operator Radiation Protection	20 10 20 15 20 10 0 0	0.5 8.7 43 0.5 0.5 0.5 0.5	d dose 1,703 se enclos 0,9 16.0 50.2 0.3 0.3 0.1 0.0	100
Load SNF into MPU/Transportation- or MPU/Total Prep MPU/Universal-overpack from SNF fran Total Prep MPU/Universal-overpack from SNF fran Total In third Personnel Barrier m. Instal Personnel Barrier m. Coen Receiving and Shipping Bay Door, m. Hitch Ste Prime Mover	Storage 100 ster cell 3,255 ster Cell 3,255	0 stores 1,235 1100 1100 1100 35 35 35 0 0	pping 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	crane Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operator Radiation Protection Operator Prime Mover Operator Operator Prime Mover Operator Operator	20 10 20 15 20 10 0 0 15	0.5 8.7 43 0.5 0.5 0.5 0.5 0.5	d dose 1,703 e enclos 0,9 16.0 50.2 0.3 0.3 0.1 0.0	100
Load SNF into MPU/Transportation- or MPU/Total Peop MPU/Universal-overpack from SNF frantotal Peop MPU/Universal-overpack from SNF frantotal In Install Personnel Barrier In 1. Open Receiving and Shipping Bay Door, 1912. Hitch Ste Prime Mover 1913. Prepare Shipping Papers	Storage 100 100 ster cell 1 3,255 nister Cell 36	tor Shight 1100 1100 1100 1100 1100 1100 1100 11	pping 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	casume crane enclosur Crane Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operator Radiation Protection Operator Prime Mover Operator Operator Operator Operator Operator	200 100 20 15 200 10 0 0 15	0.5 8.7 43 0.5 0.5 0.5 0.5 0.5 8.7 0 0.5	d dose 1,703 se enclos 0,9 16.0 50.2 0.3 5.1 0.0 0.1 2,9	
Load SNF into MPU/Transportation- or MPU/Testal Prep MPU/Universal-overpack from SNF from Total Prep MPU/Universal-overpack from SNF from Total In the MPU/Universal-overpack from SNF from SNF from Install Personnel Borrier In 1. Open Receiving and Shipping Bay Door, 1972. Hitch Sile Prime Mover 1973. Pepare Shipping Pagets In Move Crist to Profested Area Galle	Storage 100 100 ster cell 1 3,255 ster Cell 100 35 100 100 100 100 100 100 100 100 100 10	0 stores 1,235 10 110 110 35 35 35 35 36 10 10 10	ping 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Crans Operator Radiation Protection Operator Prime Mover Operator Crans Operator Radiation Protection Operator Readiation Protection Operator	20 10 20 15 20 10 0 0 15 15	0.5 8.7 43 0.5 0.5 0.5 0.5 8.7 0.5 0.5	1,703 1,703 1,703 16.0 50.2 0.3 5.1 0.0 0.1 0.0 2,9	
Load SNF into MPU/Transportation- or MPU/Transportation- or MPU/Transportation- or MPU/Transportation- or MPU/Transportation- or MPU/Transportation- or MPU/Transportation- sNF from Total The MPU/Universal-overpack from SNF from the MPU/Universal-overpack from SNF from the MPU/Transportation SNF from the MPU/Transportation SNF from the MPU/Transportation SNF from the MPU/Transportation SNF from SNF from MPU/Transportation SNF from SNF from MPU/Transportation SNF from SNF	Storage 100 100 ster cell 1 3,255 ster Cell 100 35 100 100 100 100 100 100 100 100 100 10	0 stores 1,235 10 110 110 35 35 35 35 36 10 10 10	phig 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	crane Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operator Radiation Protection Operator Prime Mover Operator	20 10 20 15 20 10 0 0 15 15 20 20 10 10 20 20 20 20 20 20 20 20 20 20 20 20 20	0.5 8.7 43 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	1,703 1,703 1,703 1,703 0,9 1,00 5,02 0,3 5,1 0,0 0,1 0,0 2,9 0,1 0,0 0,1 0,0 0,0 0,0 0,0 0,0	
Load SNF into MPU/Transportation- or MPU/Telat 7. Prep MPU/Universal-overpack from SNF frantotal 8. Prep MPU/Universal-overpack from SNF frantotal 9. Install Personnel Barrier 10. Install Personnel Barrier 10. Copen Receiving and Shipping Bay Door, 10. Pitch Sile Prime Mover 10. Pitch Sile Prime Mover 10. Prove Crist to Protected Area Galle	Storage 100 100 ster cell 1 3,255 ster Cell 100 35 100 100 100 100 100 100 100 100 100 10	tor Ship 1100 35 35 35 35 36 36 36 36 36 36 36 36	ping 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Crans Operator Radiation Protection Operator Prime Mover Operator Crans Operator Radiation Protection Operator Readiation Protection Operator	200 100 100 100 100 100 100 100 100 100	0.5 8.7 433 0.5 0.5 0.5 8.7 0 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0	d dose 1,703 0.9 16.0 50.2 0.3 5.1 0.0 0.1 0.0 2.9 0.1	
Load SNF into MPU/Transportation- or MPU/Total Prep MPU/Universal-overpack from SNF fran Total Prep MPU/Universal-overpack from SNF fran Storage - 100 stier cell 3,255 stier Cell 3,255 stier Cell 355 crane en	1,235 10 storo 1,235 10 110 110 110 135 35 35 00 10 10 10 10 10 10 10 10 10 10 10 10	phing 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	crane Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operator Radiation Protection Operator Prime Mover Operator Operator Operator Operator Operator Operator Operator Operator Operator Security Officers	200 100 155 200 100 105 105 105 105 105 105 105 105 1	0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	d dose 1,703 se encios 0,9 16.0 50.2 50.3 5.1 0.0 0,1 0.1 0.0 1.5.2 9		
Load SNF into MPU/Transportation- or MPU/Total Peep MPU/Universal-overpack from SNF from Total Peep MPU/Universal-overpack from SNF from Total In Install Personnel Barrier In I. Open Receiving and Shipping Bay Door, 1972. Hitch Ste Prime Mover 1973. Prepare Shipping Papers 1975. Move Cask to Protected Area Gate (assume rail stding background dose same as (assume rail background while moving) DO. Perform Security check	Storage 100 ster cell 3,255 ster Cell 3,255 ster Cell 36 ster Cell 100 20 100 100 100 100 100 100 100 100 1	0 10 10 10 10 10 10 10	pring 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	crane operator Rodiation Protection Operators Prime Mover Operator Rodiation Protection Operator Rodiation Protection Operator Rodiation Protection Operator Prime Mover Operator Operator Prime Mover Operator Operator Rodiation Protection Rodiation Protection Security Officers	2000 100 100 100 100 100 100 100 100 100	0.5 0.5 8.7 43 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	d dose 1,703 se endos 0,9 16.0 50.2 50.3 5.1 0.0 0,1 0.0 2.9 0.1 1.5 2.8	
Load SNF into MPU/Transportation- or MPU/Total Peep MPU/Universal-overpack from SNF from Total Peep MPU/Universal-overpack from SNF from Total In Install Personnel Barrier In I. Open Receiving and Shipping Bay Door, 1972. Hitch Ste Prime Mover 1973. Prepare Shipping Papers 1975. Move Cask to Protected Area Gate (assume rail stding background dose same as (assume rail background while moving) DO. Perform Security check	Storage 100 ster cell 3,255 ster Cell 3,255 ster Cell 36 ster Cell 100 20 100 100 100 100 100 100 100 100 1	1,235 10 10 10 10 10 10 10 1	pping 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	casume crane enclosur Crans Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operator Readiation Protection Operator	200 100 100 100 100 100 100 100 100 100	0.5 8.7 43 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	d dose 1,703 e endos 0.9 16.0 50.2 0.3 0.3 0.1 0.0 0.1 1.5 1.5 0.0 0.0 0.1 0.1 0.0 0.0 0.1 0.0 0.0 0.0	
Load SNF into MPU/Iransportation- or MPU/ Total Prep MPU/Universal-overpack from SNF from Total Prep MPU/Universal-overpack from SNF from Total In Install Personnel Barrier In I. Open Receiving and Shipping Bay Door, In I. Hitch Site Prime Mover In I. Prepare Shipping Paper In I. Open Receiving and Shipping Bay Door, In I. Hitch Site Prime Mover In I. Prepare Shipping Paper In I. Open Receiving and Shipping Bay Door, In I. Hitch Site Prime Mover In I. Prepare Shipping Paper In I. White Site Prime Mover In I. White Stephan Security Check In I. White Mover In I. White Site Prime Mover II. White Site Prime Mover II. White Site Prime Mover III. White Site Prime	Storage - 100 100 ster cell 3,255 ster Cell 3,255 ster Cell 3,255 ster Cell 2,255 ster Cell 3,255 ster Cell	1,235 10 10 10 10 10 10 10 1	points 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	casume crane enclosur Crane Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operator Radiation Protection Operator Prime Mover Operator Operator Prime Mover Operator Operator Prime Mover Operator Operator Prime Mover Operator	200 100 22 155 200 100 100 100 100 100 100 100 100 100	0.5 8.7 43 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0 dose 1,703 0 e enclos 0.9 16.0 50.2 0.3 5.1 0.0 0.1 1.5 0.0 1.5 0.0 1.5 0.0 1.5 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.1 0.0 0.0	
Load SNF into MPU/Iransportation- or MPU/ Total Prep MPU/Universal-overpack from SNF fran Total Prep MPU/Universal-overpack from SNF fran Total In Install Personnel Barrier In I. Open Receiving and Shipping Bay Door, In I. Hitch Site Prime Mover In I. Prepare Shipping Papers In I. Prepare Shipping Papers In I. Move Cask to Protected Area Gate (assume rail siding background dose same as (assume rail background while moving) I. Unhitch On-Site Prime Mover In I. Make-up with offer cask cars per frain (a	Storage - 100 100 100 100 100 100 100 100 100 100	1,235 10 10 10 10 10 10 10 1	ping 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	crane crane enclosur Crane Operator Radiation Protection Operators Prime Mover Operator Crane Operator Radiation Protection Operator Prime Mover Operator Operator Operator Operator Operator Operator Prime Mover Operator Operator Radiation Protection Radiation Protection Security Officers Operators Prime Mover Operator Operators Operators Operators	200 100 22 155 200 100 100 100 100 100 100 100 100 100	0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0 dose 1,703 0 enclose 0.9 16.0 50.2 0.3 5.1 0.0 0.1 0.0 1.5 2.8 1.5 1.5 1.5 1.5 2.8 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5	
Load SNF into MPU/Iransportation- or MPU/ Total Prep MPU/Universal-overpack from SNF fran Total Prep MPU/Universal-overpack from SNF fran Total In Install Personnel Barrier In I. Open Receiving and Shipping Bay Door, In I. Hitch Site Prime Mover In I. Prepare Shipping Papers In I. Prepare Shipping Papers In I. Move Cask to Protected Area Gate (assume rail siding background dose same as (assume rail background while moving) I. Unhitch On-Site Prime Mover In I. Make-up with offer cask cars per frain (a	Storage - 100 100 100 100 100 100 100 100 100 100	1235 100	ping 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	casume crane enclosur Crane Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operator Radiation Protection Operator Prime Mover Operator Operator Prime Mover Operator Operator Prime Mover Operator Operator Prime Mover Operator	200 100 22 155 200 100 100 100 100 100 100 100 100 100	0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	d dose 1,703 se encios 0,9 16.0 50.2 0.3 0.3 0.1 0.0 0.1 0.0 1.5 1.5 1.5 0.0 0.0 1.5 1.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	
Load SNF into MPU/Iransportation- or MPU/ Total Peep MPU/Universal-overpack from SNF from Total Peep MPU/Universal-overpack from SNF from Total Peep MPU/Universal-overpack from SNF from Total In Install Personnel Barrier In I. Open Receiving and Shipping Bay Door, and The High Site Prime Mover In I. Open Receiving and Shipping Bay Door, and The High Site Prime Mover In I. Open Receiving and Shipping Bay Door, and The High Site Prime Mover In I. Open Receiving and Shipping Bay Door, and The High Site Prime Mover In I. Unlited On-Site Prime Mover In I. Make-up with other cask cas per from (and In Ithich Off-Site Prime Mover In I. High Off-Site Prime Mover	Storage 100 ster cell 3,255 site Cell 3,255 site Cell 365 3,255 3,	1,235 100 10	ping 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	crane crane enclosur Crane Operator Radiation Protection Operators Prime Mover Operator Crane Operator Radiation Protection Operator Prime Mover Operator Operator Operator Operator Operator Operator Prime Mover Operator Operator Radiation Protection Radiation Protection Security Officers Operators Prime Mover Operator Operators Operators Operators	200 100 22 155 200 100 100 100 100 100 100 100 100 100	0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0 dose 1,703 0 enclose 0.9 16.0 50.2 0.3 5.1 0.0 0.1 0.0 1.5 2.8 1.5 1.5 1.5 1.5 2.8 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5	
Load SNF into MPU/Iransportation- or MPU/ Total Prep MPU/Universal-overpack from SNF fran Total Prep MPU/Universal-overpack from SNF fran Total In Install Personnel Barrier In I. Open Receiving and Shipping Bay Door, In I. Hitch Site Prime Mover In I. Prepare Shipping Papers In I. Prepare Shipping Papers In I. Move Cask to Protected Area Gate (assume rail siding background dose same as (assume rail background while moving) I. Unhitch On-Site Prime Mover In I. Make-up with offer cask cars per frain (a	Storage 100 ster cell 3,255 site Cell 3,255 site Cell 365 3,255 3,	1,235 100 10	ping 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	crane crane enclosur Crane Operator Radiation Protection Operators Prime Mover Operator Rodiation Protection Operator Rodiation Protection Operator Prime Mover Operator Operator Operator Inchesion Prime Mover Operator Radiation Protection Rediation Protection Security Officers Operators Prime Mover Operator Operators Prime Mover Operator Operators Prime Mover Operator Operators Prime Mover Operator	200 100 100 100 100 100 100 100 100 100	0.5 8.7 433 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0 dose 1,703 0 e enclos 0.9 16.0 50.2 0.3 5.1 0.0 0.1 1.5 0.0 1.5 0.0 2.8 1.5 0.0 0.1 1.5 0.0 0.1 1.5 0.0 0.1 1.5 0.0 0.1 1.5 0.0 0.1 1.5 0.0 0.1 1.5 0.0 0.1 1.5 0.0 0.1 1.5 0.0 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	
Load SNF into MPU/Iransportation- or MPU/ Total Prep MPU/Universal-overpack from SNF from Total Prep MPU/Universal-overpack from SNF from Total In Install Personnel Barrier In I. Open Receiving and Shipping Bay Door, In 2. Hitch Site Prime Mover In 3. Prepare Shipping Papers Do. Move Cask to Protected Area Galle (assume rail siding background dose same as (assume rail background while moving) pp. Perform Security check pp.1. Unhitch On-Site Prime Mover agg. Make-up with other cask cars per train (as	Storage 100 ster cell 3,255 site Cell 3,255 site Cell 365 3,255 3,	1,235 100 10	ping 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	crane crane enclosur Crane Operator Radiation Protection Operators Prime Mover Operator Crane Operator Radiation Protection Operator Prime Mover Operator Operator Operator Operator Operator Operator Prime Mover Operator Operator Radiation Protection Radiation Protection Security Officers Operators Prime Mover Operator Operators Operators Operators	CBSUF 20 10 10 15 15 20 10 10 15 15 15 15 15 15 15 15 15 15 15 15 15	0.5 8.7 433 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	d dose 1,703 e endos 0.9 16.0 50.2 0.3 5.1 0.0 0.1 1.5 1.5 1.5 1.0.0 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5	
Load SNF into MPU/Iransportation- or MPU/ Total Prep MPU/Universal-overpack from SNF from Total Prep MPU/Universal-overpack from SNF from Total In Install Personnel Barrier In Linstall Personnel Barrier In Linsta	Storage - 100 100 stier cell 3,255 3,255 stier Cell 3,255 100 100 200 100 100 100 100 100 100 100	1235 100	points 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	crane crane enclosur Crane Operator Radiation Protection Operators Prime Mover Operator Rodiation Protection Operator Rodiation Protection Operator Prime Mover Operator Operator Operator Inchesion Prime Mover Operator Radiation Protection Rediation Protection Security Officers Operators Prime Mover Operator Operators Prime Mover Operator Operators Prime Mover Operator Operators Prime Mover Operator	CBSUF 20 10 10 15 15 20 10 10 15 15 15 15 15 15 15 15 15 15 15 15 15	0.5 8.7 43 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	d dose 1,703 1,703 1,703 1,703 1,00 1,00 1,00 1,00 1,00 1,00 1,00 1,	
Load SNF into MPU/Iransportation- or MPU/ Total Prep MPU/Universal-overpack from SNF from Total Prep MPU/Universal-overpack from SNF from Total In Install Personnel Barrier In I. Open Receiving and Shipping Bay Door, In 2. Hitch Site Prime Mover In 3. Prepare Shipping Papers In Move Cask to Protected Area Galle Cassume rail siding background dose same as Cassume rail siding background dose same as Cassume rail background while moving) In Inhitch On-Site Prime Mover In Make-up with other cask cars per frain (as Ir. Hitch Off-Site Prime Mover Total	Storage 100 ster cell 3,255 site Cell 3,255 site Cell 365 3,255 3,	1235 100	points 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	casume crane enclosur Crane Operator Radiation Protection Operators Prime Mover Operator Rodiation Protection Operator Rodiation Protection Operator Prime Mover Operator Operator Operator Operator Prime Mover Operator Operator Operator Operator Prime Mover Operator Operator Operator Prime Mover Operator Operator Operator Operator Prime Mover Operator	CSSUF	0.5 8.7 433 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	d dose 1,703 se encios 0,9 16.0 50.2 0.3 0.3 0.1 0.0 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	
Load SNF into MPU/Iransportation- or MPU/ Total Prep MPU/Universal-overpack from SNF from Total Prep MPU/Universal-overpack from SNF from Total In Install Personnel Barrier In Linstall Personnel Barrier In Linsta	Storage - 100 100 stier cell 3,255 3,255 stier Cell 3,255 100 100 200 100 100 100 100 100 100 100	1,235 100 10	pring 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	casume crane enclosur Crane Operator Radiation Protection Operators Prime Mover Operator Crane Operator Radiation Protection Operator Prime Mover Operator Operator Operator Prime Mover Operator Operator Operator Radiation Protection Radiation Protection Security Officers Operators Prime Mover Operator Operators	CSSUF	0.5 8.7 433 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	d dose 1,703 se endos 0.9 16.0 50.2 5.1 0.0 0.1 0.1 0.1 1.5 0.0 1.5 1.5 0.0 1.873 1.873 and dose	
Load SNF into MPU/Iransportation- or MPU/ Total Prep MPU/Universal-overpack from SNF from Total Prep MPU/Universal-overpack from SNF from Total In Install Personnel Barrier In Linstall Personnel Barrier In Linsta	Storage - 100 100 stier cell 3,255 3,255 stier Cell 3,255 100 100 200 100 100 100 100 100 100 100	1,235 10 10 10 10 10 10 10 1	poing 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Casume crane enclosur Crane Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operator Radiation Protection Operator Prime Mover Operator Operator Operator Prime Mover Operator Crane Operator Radiation Protection Security Officers Operators Prime Mover Operator Coperator Radiation Protection Security Officers Operators Prime Mover Operator Operators Prime Mover Operator Coperators Prime Mover Operator Cossume initially in ISFSI Operators Prime Mover Operator	CBSUF 20 20 10 10 10 10 10 10 10 10 10 10 10 10 10	0.5 8.7 433 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	d dose 1,703 se endos 0.9 16.0 50.2 0.3 0.3 0.1 0.0 0.1 0.1 0.1 1.5 0.0 0.2 1,873 1,873 1,873 1,873	
Load SNF into MPU/Iransportation- or MPU/ Total Prep MPU/Universal-overpack from SNF fran Total Prep MPU/Universal-overpack from SNF fran Total Prep MPU/Universal-overpack from SNF fran Total In Install Personnel Barrier In I. Open Receiving and Shipping Bay Door, Int Pitch Site Prime Mover In I. Prepore Shipping Papers In I. Hitch Site Prime Mover In I. Prepore Shipping Papers In I. White Site Prime Mover In I. Unitich On-Site Prime Mover In I. Unitich On-Site Prime Mover In I. Make-up with office cask cas per froin (a II. Hitch Off-Site Prime Mover Total P. Prep MPU from Storage for Shipping Install Cask Closure	Storage - 100 100 100 100 100 100 100 100 100 100	1,235 100 10	poing 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	casume crane enclosur Crans Operator Radiation Protection Operator Prime Mover Operator Radiation Protection Operator Radiation Protection Operator Prime Mover Operator Operator Prime Mover Operator Operator Prime Mover Operator Operator Radiation Protection Security Officers Operators Prime Mover Operator Operator Prime Mover Operator Operators Prime Mover Operator Operators Prime Mover Operator Casume inflictly in ISFSI Operators Prime Mover Operator	CBSUF 20 20 10 10 10 10 10 10 10 10 10 10 10 10 10	0.5 8.7 43. 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.	d dose 1,703 se endos 0.9 16.0 50.2 0.3 0.3 0.1 0.0 0.1 0.1 0.1 1.5 0.0 0.2 1,873 1,873 1,873 1,873	
Load SNF into MPU/Transportation- or MPU/Total Prep MPU/Universal-overpack from SNF frantati Prep MPU/Universal-overpack from SNF frantati In Install Personnel Barrier In Install Per	Storage - 100 100 stier cell 3,255 3,255 stier Cell 3,255 stier Cell 10 20 20 crane en	1235 100	points 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	casume crane enclosur Crane Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operator Radiation Protection Operator Prime Mover Operator	Cass_F 20 10 20 10 0 0 0 15 0 0 15 15 20 10 10 11 15 11 11 11 11 11 11 11 11 11 11 11	0.5 8.7 43. 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.	d dose 1,703 e endos 0.9 16.0 50.2 0.3 5.1 0.0 0.1 1.5 0.0 1.5 0.0 1.5 0.0 1.5 0.0 1.5 0.0 1.5 0.0 1.5 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0	
Load SNF into MPU/Iransportation- or MPU/ Total Prep MPU/Universal-overpack from SNF from Total Prep MPU/Universal-overpack from SNF from Total In Install Personnel Barrier In Install Personnel Barrier In I. Open Receiving and Shipping Bay Door, Inv. Hitch Site Prime Mover In 3. Prepare Shipping Papers In Move Cask to Protected Area Gate Iossume rail siding background dose same as Iossume rail background while moving) In Install Constitution of the Prime Mover In Make-up with other cask cas per froin (a. I. Hitch Off-Site Prime Mover Total P. Prep MPU from Storage for Shipping a. Install Cask Closure	Storage - 100 100 stier cell 3,255 3,255 stier Cell 3,255 stier Cell 10 20 20 crane en	1,235 100 10	pping 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	crane crane enclosur Crane Operator Radiation Protection Operators Prime Mover Operator Crane Operator Radiation Protection Operator Prime Mover Operator Operator Operator Prime Mover Operator Operator Operator Radiation Protection Radiation Protection Security Officers Operators Prime Mover Operator Operators I Prime Mover Operator Crane Operator Operators I Prime Mover Operator Operators I Prime Mover Operator I Crane Operator Radiation Protection I Prime Mover Operator Operators I Prime Mover Operator Radiation Protection I Crane Operator	Casa_F 20 10 10 15 15 15 15 15 1	0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	d dose 1,703 1,703 1,703 1,703 1,00 1	
Load SNF into MPU/Transportation- or MPU/Total Prep MPU/Universal-overpack from SNF frantati Prep MPU/Universal-overpack from SNF frantati In Install Personnel Barrier In Install Per	Storage - 100 100 stier cell 3,255 3,255 stier Cell 3,255 stier Cell 10 20 20 crane en	1235 100	poing 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	casume crane enclosur Crane Operator Radiation Protection Operators Prime Mover Operator Radiation Protection Operator Radiation Protection Operator Prime Mover Operator	200 100 200 115 150 150 150 150 150 150 150 150 1	0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	d dose 1,703 se endos 0,9 16.0 50.2 5.1 0.0 0.1 0.1 0.1 1.5 0.0 1.873	3

Table A1-7. MRS-MPU (continued)

c. Perform Shipping HP Survey Cask	7/0			Operators	10			4.7
		70	1	Prime Mover Operator	15		0.6	23
		70		Crane Operator	20		0.6	
	L	70	1	Radiation Protection	2			
d Decontaminate Cask	60			Operators	2		7.2	0.3
(If needed)		5		Prime Mover Operator				
		5		Crane Operator	20	0.5		
		5		Radiation Protection	10			0.2
Install Cask Restraints	70			Operators	2	32		4.7
		70		Pitme Mover Operator	15	0.5	0.6	23
		70		Crane Operator	20	0.5		23
		70		Radiation Protection	10	8.7	10.2	23
f. Install impact Limiters and Neutron Shields	110			Operators	2	32	117.3	7.3
		110		Prime Mover Operator	15	0.5	0.9	
		110		Crane Operator	20	0.5	0.9	3.7
		110	1	Radiation Protection	10	8.7	16.0	3.7 3.7
g. Install Personnel Barrier	35			Operators	2	322	37.3	23
		35		Prime Mover Operator	15	0.5	3	1.2
		35		Crane Operator	20	0.5	0.3	1.2
		35		Radiation Protection	10	8.7	5.1	1.2
it Prepare Shipping Papers	20)	0		Operator	10	8.7	9.9	0.0
		0		Prime Mover Operator	15	0.5	0.0	0.0
		٥	1	Crane Operator	20	0.5	8	0.0
		0	1	Radiation Protection	10	8.7	0.0	0.0
h1, http://on-Ste PM	5	5	2	Operators	10	8.7	1.5	0.3
		5	1	Prime Mover Operator	15	0.5	0.0	0.2
i. Move Cask to ISFSI Protected Area Gate	10	10	2	Operators	10	8.7	29	0.7
		10	1	Prime Mover Operator	15	0.5	0.1	0.3
		10	1	Crane Operator	20	0.5	0.1	0.2
		10	1	Radiation Protection	10	8.7	1.5	0.3
J. Unhitch On-Site PM	5	5	2	Operators	10	8.7	1.5	0.0
(rull background dose)		5	1	Prime Mover Operator	15	0.5	0.0	0.0
k. Hitch Off-Site PM	5	5	2	Operators	10	8.7	1.5	0.0
		5		Pitme Mover Operator	15	0.5	0.0	0.0
Total	510	1.710					861.5	70.5

Table A1-8. MRS-MPC

otal Doses per Cask Handling for MPC at the MRS		ļ		Rail mrem/hr	 	Backg mrem/		
evised 2 June 94/HWG				Lid doses		Cred		
	Direct		Sum	inner				
oad MPC for Shipping	(person-			outer		crane		
Steps - (10,11,12,13,14,16)	1.873	71	1945	Tp/Tx cask lid	*******		3	
		L		Lateral Skin		pool		
oad MPC for Storage		L	<u> </u>	Storage cask mrem/h		ISPSI	4	
Steps - (10,11,12,13,14,15)	1,703	26	1.731	Ud doses	-			
		<u> </u>	L	inner		nul	9	
ransfer MPC into Storage			<u> </u>	outer	97			
Steps - (1.2.3.4)	1,438	19	1.457	Tp/Tx cask id	70			
318px - (12.877)				Lateral Skin	70			
ransier MPC from storage for shipping								
Steps - (5,6,7,8,9)	1,534	86	1,520					
(۴,۵ ۲,۵,۵) - عراقاد								
and the booleans			1					
rail flow Through all technologies	├──		 					
Shown on MRS- RDS spreadsheet		-	 					
	otel Tesk Time(Mn.)	Does throughton	Peanonnal Decripted (Peanons/Tosk)	oos mothon	Working Distances(Feet)	Cask Dose Rate(mem/ht)	Dose Received(Ревоп-плет)	Facility dose background (person-men
Cask Handling Operations	+		-	· · · · · · · · · · · · · · · · · · ·	1 -	1		
Receive and Prep MPC/Transportation-	+	+		cssume null backgrou	nd do	se initik	zily	
overpack for MPC transfer	 	1	. - 	Operator	1 0		0.0	0.00
a. Inspect Bills of Lading, Other Shipping Papers	10	_	5	Prime Mover Operato				
b. Puti Cask into Security Area					1 2			0.00
c. Security Inspection	A			2 Security Officers				
d. Perform HP Survey of Cask Externals and RR car	3			2 Radiation Protection	1 .2			
Take Cask to Protected Area	10			Prime Mover Operato				
f. Unhitch Off-Site Prime Mover	10			Prime Mover Operato				
the Lab - Direct March	1	0 1		1 Prime Mover Operato				
g. Hitch Site Prieme Mover h. Take Cask to Receiving and Shipping Bay Door	31	0 1		Prime Mover Operato				
ht. Open Receiving and Shipping Bay Door, simultaneous	1	J		1 Operator		9(
i. Take Cask into Receiving and Shipping Bay		5	5	1 Prime Mover Operate				+
L TOME COMMITTEE TO THE PERSON OF THE PERSON			5	1 Ragman	K			
i. Unhitch Site Prime Mover	1	0 1	0	1 Prime Mover Operate	x 15			
Unnited Site Prints Move L. Close Receiving and Shipping Bay Door, simultaneous	1	1		1 Operator	1 (0.0	0.00
L Close Receiving and suppling buy book suit suit and to be	1 2	5 2	5	2 Operators	1	2 32	26.7	0.00
k. Remove Personnel Barrier	 		5	1 Crane Operator	2	0.5	0.2	0.00
			0	2 Radiation Protection		2 4	143	0.0
L HP Survey				2 Operators		3 3		
m. Remove Impact Limiters			_	1 Crane Operator	2	_		0.36
			0			2 3		0.4
n. Remove Tiedowns	+5		<u> </u>	2 Operators	2			_
			:이	1 Crane Operator		2 3	_	
o. Remove Trunnion Blocks			10	2 Operators	2			_
			10	1 Crane Operators				
p. Attach Crane to Yoke		5	5	1 Operators				
			5	1 Rogmon			0 00	
			5	1 Crane Operator	2		0.00	
	T	5	5	1 Operators		2 1		
a Foogge Yoke to Cask		.	5	1 Ragman	_	0 8.		
q. Engage Yoke to Cask			5	1 Crane Operator		0 0		
q. Engage Yoke to Cask		1	ગ		1	O	0 01	
		5	8	1 Operator				5 0.0
r Onen Prep Room Door	96		0	1 Operator 2 Operators		0 1.	B 0.4	
	94	5	0 10		1		5 0.	
r. Open Prep Room Door s. Move Cask Into Transport Cask Prep Room Washdown Ar		10	0 10 10	2 Operators 1 Crane Operator	1 2	0 1.	5 0.	
Open Prep Room Door Move Cask Into Transport Cask Prep Room Washdown Ar Install Platform			0 10 10	2 Operators 1 Crane Operator 1 Operator	2	0 1. 0 0. 6 8.	5 0.	5 0.0
f. Open Prep Room Door s. Move Cask Into Transport Cask Prep Room Washdown Ar f. Install Platform tt. Close SNF Transport Cask Prep Room Door, simultaneous		10	0 10 10 10	2 Operators 1 Crane Operator 1 Operator 1 Operator	2	0 1. 0 0. 6 8.	5 0. 7 1. 0 0.	5 0.0
Open Prep Room Door Move Cask Into Transport Cask Prep Room Washdown Ar Install Platform		10	0 10 10 10 0	2 Operators 1 Crane Operator 1 Operator 1 Operator 2 Operators	2	0 1. 0 0. 6 8. 0 2 1	5 0. 7 1. 0 0. 7 17.	5 0.0 0 0.0 0 0.2
Open Prep Room Door Move Cask Into Transport Cask Prep Room Washdown Ar Install Platform Cose SNF Transport Cask Prep Room Door, simultaneous		10 10 30 35	0 10 10 10 0 30	2 Operators 1 Crane Operator 1 Operator 1 Operator 2 Operators 1 Radiation Protection	1 2	0 1. 0 0. 6 8. 0 2 1 2 4	5 0. 7 1. 0 0. 7 17. 3 10.	5 0.0 0 0.0 0 0.2 8 0.0
r. Open Prep Room Door s. Move Cask Into Transport Cask Prep Room Washdown Ar t. Install Platform tt. Close SNF Transport Cask Prep Room Door, simultaneous u. Washdown Cask v. HP Survey w. Remove Platform		10 10 30 35 10	0 10 10 10 0 30 15	2 Operators 1 Crane Operator 1 Operator 1 Operator 2 Operators 1 Radiction Protection 1 Operator	1 2	0 1. 0 0. 6 8. 0 2 1 2 4 6 8.	5 0. 7 1. 0 0. 7 17. 3 10. 7 1.	5 0.0 0 0.0 0 0.2 8 0.0 5 0.0
r. Open Prep Room Door s. Move Cask Into Transport Cask Prep Room Washdown Ar t. Install Platform tt. Close SNF Transport Cask Prep Room Door, simultaneous u. Washdown Cask v. HP Survey w. Remove Platform		10 10 30 35	0 10 10 10 0 30 15 10	2 Operators 1 Crane Operator 1 Operator 1 Operator 2 Operators 1 Radiction Protection 1 Operator 2 Operator	2	0 1. 0 0. 6 8. 0 2 1 2 4 6 8.	5 0. 7 1. 0 0. 7 17. 3 10. 7 1. 8 0.	5 0.0 0 0.0 0 0.2 8 0.0 5 0.0 6 0.0
Open Prep Room Door Move Cask Into Transport Cask Prep Room Washdown Ar Install Platform Close SNF Transport Cask Prep Room Door, simultaneous Washdown Cask HP Survey		10 30 35 10 10	0 10 10 10 0 30 15 10	2 Operators 1 Crane Operator 1 Operator 2 Operators 1 Radiation Protection 1 Operator 2 Operator 1 Operator 2 Operator 1 Operator 2 Operators	2	0 1. 0 0. 6 8. 0 2 1 2 4 6 8. 0 1.	5 0. 7 1, 0 0, 7 17, 3 10, 7 1, 8 0, 5 0.	5 0.0 0 0.0 0 0.2 8 0.0 5 0.0 6 0.0 1 0.0
r. Open Prep Room Door s. Move Cask Into Transport Cask Prep Room Washdown Ar t. Install Platform tl. Close SNF Transport Cask Prep Room Door, simultaneous u. Washdown Cask v. HP Survey w. Remove Platform		10 10 30 35 10	0 10 10 10 0 30 15 10	2 Operators 1 Crane Operator 1 Operator 1 Operator 2 Operators 1 Radiction Protection 1 Operator 2 Operator	2	0 1,0 0.66 8.00 22 11 22 44 66 8.00 1.80 0.00 8	5 0. 7 1, 0 0, 7 17, 3 10, 7 1, 8 0, 5 0.	5 C C C C C C C C C C C C C C C C C C C

						101	11.0	~
. Secure Cask to Carrier	20	20		Operators	2	17	11.3	0.17
zi . Disengage Crane with Yoke from Cask, simultaneous		10		Operator	2	17	2.8	0.0
		10		Ragman	10	8.7	1.5	0.0
		10	1	Crane Operator	20	0.5	0.1	0.0
ag, Open MPC Transfer Room Door	5	0	ī	Operator	. 0	0	0.0	0.0
bb. Move Cask Carrier into MPC Transfer Room	45	45	1	Operator	10	8.7	6.5	0.19
30. MOVE COSK CORRECTIONS C HOUSING ROOM	 ~	0		Operator	0	0	0.0	0.00
bbl. Close MPC Transfer Room Door	 ,	10		Operator	2	97	162	0.0
cc. Attach Vent Rig	10				2	394	3.3	on
dd. Vent Cask Cavilly	10	5		Operator				
ddi. Instati Platform Extension	11	10	1	Operator	6	8.7	1.5	0.0
ee. Remove Vent Rig	10	10	1	Operator	2	97	16.2	0.02
ff. Install Cask Ltd Lifting Device	20	20	2	Operators	2	97	64.7	0.17
TI. II SIGE COSK DO LINE DEVICE	 	10		Ragman	10	8.7	1.5	0.0
	}	10		Crane Operator	20	0.5	0.1	0.0
	 				2	97	145.5	0.3
gg. Loosen/Removie Cask Lid	60	45		Operators				
	1	30		Ragman	10	8.7	44	0.1
	T	30		Crane Operator	20	0.5	0.3	0.1
hh. Install Contamination Control	10	10	2	Operators	2	43	143	0.0
Mr. Esigl Consolition Attention to MCC	35	25		Operators	2	220	183.3	0.2
I. Engage MPC Crone Lifting Attachment to MPC	~	20		Ragman	10	8.7	2.9	00
	├ ──			Crane Operator	20	0.5	0.2	0.0
	 	20	4	Cigne Obergioi	- 20		754	-0.0
Total	715	1,020					/34	
		1	1					
2. Receive and Prep Storage-overpack							1	
(emplacement-overpack) for MPC Transfer				assume crane enclosu	re ba	ydlon pyc	nd dos	9
Constitution Control Prop Door Door	5	5		Operator	0	0	0.0	0.0
a. Open Storage Cask Prep Room Door	10	10		Operator	2	0	0.0	0.0
b. Engage Crane and Yoke to Storage Cask	10				10	ō	0.0	0.0
		10		Ragman	20	0	0.0	<u> </u>
		10		Crane Operator				
c. Move Cask to Empty Storage Cask Staging Area	20	20	2	Operators	10	0	0.0	0.1
C MOTO COM TO LITTON OCCUPY OF THE COM		20	ì	Crane Operator	20	٥	0.0	0.0
Control Description of the Control Description o	1	20	7	Operator	0	0	0.0	0,0
c1. Close Storage Cask Prep Door, simultaneously with c.	35	35		Radiation Protection	2	0	0.0	0.2
d. HP Survey		60		Operators	2	0	0.0	0.5
e. Decontaminate Cask	60				2	Ö	0.0	0.0
t. Move Storage Cask to Carrier	10	10		Operators			0.0	00
		10	1	Crane Operator	8	0		
g. Place Empty Storage Cask on Carrier	35	35	2	Operators	10	0	0.0	02
- Cross Elipiy Cloudy Control		35	1	Crane Operator	20	O	0.0	0.1
A. C. Carlot Olarens Corten Coriot	20	20	2	Operators	2	0	0.0	0.1
h. Secure Empty Storage Cask on Carrier		20		Operator	2	O	0.0	0.0
h1. Disengage Crane and Yoke from Starage Cask, simuli	THOUS	20		Ragmon	10	0	0.0	0.0
					20	0	00	0.0
		20		Crane Operator	نستنا		0.0	-00
i. Open MPC Transfer Room Door	5	5		Operator	0			
j. Move Empty Storage Cask to MPC Transfer Room	45	45	2	Operators	20	0	0.0	0.3
k Install Platform Extension	10	10	1	Operator	6	0	0.0	0.0
k1. Close MPC Transfer Room Door, simultaneous	 	10	1	Operator	0	0	0.0	0.0
KI, COSS MPC HOSISIGN ROOM POOR, SET CARGO TO CO	20	20	- 2	Operators	2	0	8	0.1
L Prep Empty Storcige Cask for Opening	20	20		Operator	· 2	0	ဏ	0.1
m. Attach Ud Uffing Device	1 A	20		Ragman	10	0	0.0	
	 				20	ő		_
		20		Crane Operator				_
n. Remove Cask Lid	55	55		Operators	2	_		0.4
	1	55		Ragman	10			02
	T	55	1	Crane Operator	20	0	_	02
				Operators	2	0	0.0	0.1
Program Lind Little on Providence	30	20	7	1				0.0
o. Remove Lid Lifting Device	20			Booman	1 10			
o. Remove Ud Liffing Device	20	20	1	Ragman Crane Operator	85		ותם	
		20 20	1	Crane Operator	20	0		C,
Remove Ltd Lifting Device p. Install Contamination Control	20	20 20 20	1 1 2			0	0.0	
p: Install Contamination Control		20 20 20	1 1 2	Crane Operator	20	0		
	20	20 20 20	1 1 2	Crane Operator	20	0	0.0	
p. Install Contamination Control Total	20	20 20 20	1 1 2	Crane Operator Operators	20	0	0.0	4.6
p. Install Contamination Control Total 3. Transfer MPC from Transportation-	20	20 20 20	1 1 2	Crane Operator Operators	20	0	0.0	4.6
p. Install Contamination Control Total 3. Transfer MPC from Transportation- overpack to Storage-overpack	390	20 20 20 7\$\$	1 1 2	Crane Operator Operators cossume crane enclose	20	0 0 ckgrou	0.0 0.0	4.6
p. Install Contamination Control Total 3. Transfer MPC from Transportation-	20	20 20 20 755 5	1 1 2	Crane Operator Operators assume crane enclose Operators	20 2 re bo	0 0 ckgrou 39.4	0.0 0.0 0.0 and dos	4.0
p. Install Contamination Control Total 3. Transfer MPC from Transportation- overpack to Storage-overpack	390	20 20 20 755 5	2	Crane Operator Operators assume crane enclose Operators Ragman	20 2 2 2 2 2 10	0 0 0 ckgrou 39.4 8.7	0.0 0.0 md dos 6.6	4. 0
p. Install Contamination Control Total 3. Transfer MPC from Transportation- overpack to Storage-overpack a. Engage Crane to MPC Ltft Attachment	20 390	20 20 20 7\$5 5 10	1 1 2 2 2 1 1	Crane Operator Operators cssume crane enclose Operators Ragman Crane Operator	20 2 10 20 20	0 0 ckgrou 39.4 8.7	0.0 0.0 md dos 6.6 1.5	4.6 0 0
p. Install Contamination Control Total 3. Transfer MPC from Transportation- overpack to Storage-overpack a. Engage Crane to MPC Ltft Attachment b. Verity Vertical Alignment of MPC to Transport Cask	20 390	20 20 755 5 10 10	1 1 2 2 1 1 1	Crane Operator Operators cssume crane enclose Operators Ragman Crane Operator Operator	20 2 2 2 20 20 2	0 0 ckgrou 39.4 8.7 0.5	0.0 0.0 md dos 6.6 1.5 0.1	4.6 ○ ○ ○ ○ ○ ○ ○ ○ ○
p. Install Contamination Control Total 3. Transfer MPC from Transportation- overpack to Storage-overpack a. Engage Crane to MPC Ltft Attachment b. Verity Vertical Alignment of MPC to Transport Cask	20 390	20 20 755 5 10 10	1 1 2 2 1 1 1	Crane Operator Operators cssume crane enclose Operators Ragman Crane Operator Operator	20 2 2 10 20 20 0	0 0 ckgrou 39.4 8.7 0.5	0.0 0.0 0.0 6.6 1.5 0.1 16.2	• 000000000000000000000000000000000000
p. Install Contamination Control Total 3. Transfer MPC from Transportation- overpack to Storage-overpack a. Engage Crane to MPC Lift Attachment b. Verity Vertical Alignment of MPC to Transport Cask c. Clear Operators to a Shielded Area	20 390	20 20 755 5 10 10	2 1 1 1 1 1 1 0	Crane Operator Operators cssume crane enclose Operators Ragman Crane Operator Operator	20 2 2 2 20 20 2	0 0 0 39.4 8.7 0.5 97	0.0 0.0 0.0 0.0 6.6 1.5 0.1 16.2 0.0	# C
p. Install Contamination Control Total 3. Transfer MPC from Transportation- overpack to Storage-overpack a. Engage Crane to MPC Lift Attachment b. Verity Vertical Alignment of MPC to Transport Cask c. Clear Operators to a Shielded Area c1. Close Transfer Room Doors	20 390 10 10 10 10	20 20 20 755 5 10 10 0	2 2 1 1 1 1 0 0	Crane Operator Operators assume crane encloss Operators Ragmish Crane Operator Operator (Remote	20 2 2 10 20 20 0	0 0 0 39.4 8.7 0.5 97 0	0.0 0.0 0.0 0.0 6.6 1.5 0.1 16.2 0.0	# C
p. Install Contamination Control Total 3. Transfer MPC from Transportation- overpack to Storage-overpack a. Engage Crane to MPC Lift Attachment b. Verity Vertical Alignment of MPC to Transport Cask c. Clear Operators to a Shiekled Area c1. Close Transfer Room Doors d. Raise MPC from Transportation Cask	20 390 10 10 10	20 20 20 755 5 10 10 0 0	2 2 1 1 1 0 0	Crane Operator Operators assume crane enclose Operators Ragmish Crane Operator Operator Remote Remote	20 2 2 10 20 20 0 0	0 0 39.4 8.7 0.5 1 97 0	0.0 0.0 0.0 0.0 6.6 1.5 0.1 16.2 0.0 0.0	4.0 0 0
p. Install Contamination Control Total 3. Transfer MPC from Transportation- overpack to Storage-overpack a. Engage Crane to MPC Lift Attachment b. Verity Vertical Alignment of MPC to Transport Cask c. Clear Operators to a Shielded Area c1. Close Transfer Room Doors d. Raise MPC from Transportation Cask e. Move MPC Over Storage Cask	20 390 10 10 10 30 5	20 20 20 7\$5 10 10 0 0	2 2 1 1 1 1 0 0	Crane Operator Operators assume crane enclose Operators Ragman Crane Operator Operator Remote Remote Remote	20 2 3 3 10 20 20 0 0 0	0 0 0 39.4 8.7 0.5 97 0	0.0 0.0 0.0 0.0 6.6 1.5 0.1 16.2 0.0 0.0	000000000000000000000000000000000000000
p. Install Contamination Control Total 3. Transfer MPC from Transportation- overpack to Storage-overpack a. Engage Crane to MPC Lift Attachment b. Verity Vertical Alignment of MPC to Transport Cask c. Clear Operators to a Shiekded Area c1. Close Transfer Room Doors d. Raise MPC from Transportation Cask e. Move MPC Over Storage Cask f. Verity Vertical Alignment of MPC to Storage Cask	20 390 10 10 10 30 5	20 20 20 7\$5 10 10 0 0 0	2 2 1 1 1 1 0 0 0	Crane Operator Operators assume crane encloss Operators Ragman Crane Operator Operator Remote Remote Remote Remote	20 2 20 20 20 20 0 0 0 0	0 0 39.4 8.7 0.5 97 0 0	0.0 0.0 0.0 6.6 1.5 0.1 16.2 0.0 0.0 0.0	000000000000000000000000000000000000000
p. Install Contamination Control Total 3. Transfer MPC from Transportation- overpack to Storage-overpack a. Engage Crane to MPC Lift Attachment b. Verity Vertical Alignment of MPC to Transport Cask c. Clear Operators to a Shielded Area c1. Close Transfer Room Doors d. Raise MPC from Transportation Cask e. Move MPC Over Storage Cask f. Verity Vertical Alignment of MPC to Storage Cask	20 390 10 10 10 30 5	20 20 20 755 10 10 0 0 0 0	2 2 1 1 1 1 1 0 0 0 0 0	Crane Operator Operators assume crane enclose Operators Ragman Crane Operator Operator Crane Operator Operator Remote Remote Remote Remote Remote	20 2 10 20 20 0 0 0	0 0 0 39.4 8.7 0.5 97 0 0 0	0.0 0.0 0.0 0.0 1.5 0.1 16.2 0.0 0.0 0.0 0.0	4.6 0 0 0 0 0 0 0
p. Install Contamination Control Total 3. Transfer MPC from Transportation- overpack to Storage-overpack a. Engage Crane to MPC Lift Attachment b. Verity Vertical Alignment of MPC to Transport Cask c. Clear Operators to a Shielded Area c1. Close Transfer Room Doors d. Raise MPC from Transportation Cask e. Move MPC Over Storage Cask 1. Verity Vertical Alignment of MPC to Storage Cask q. Correct Vertical Alignment	20 390 10 10 10 30 5	20 20 20 755 10 10 0 0 0 0	2 2 1 1 1 1 1 0 0 0 0 0	Crane Operator Operators assume crane encloss Operators Ragman Crane Operator Operator Remote Remote Remote Remote	20 20 10 20 20 0 0 0 0	0 0 0 39.4 8.7 0.5 0 0 0 0 0 0	0.0 0.0 0.0 6.6 1.5 0.1 16.2 0.0 0.0 0.0 0.0	000000000000000000000000000000000000000
p. Install Contamination Control Total 3. Transfer MPC from Transportation- overpack to Storage-overpack a. Engage Crane to MPC Lift Attachment b. Verity Vertical Alignment of MPC to Transport Cask c. Clear Operators to a Shiekded Area c1. Close Transfer Room Doors d. Raise MPC from Transportation Cask e. Move MPC Over Storage Cask f. Verity Vertical Alignment of MPC to Storage Cask	20 390 10 10 10 30 5 10 20	20 20 20 755 10 10 0 0 0 0	2 2 1 1 1 1 0 0 0 0 0 0 0	Crane Operator Operators assume crane enclose Operators Ragman Crane Operator Operator Crane Operator Operator Remote Remote Remote Remote Remote	20 2 10 20 20 0 0 0	0 0 0 39.4 8.7 0.5 0 0 0 0 0 0	0.0 0.0 0.0 6.6 1.5 0.1 16.2 0.0 0.0 0.0 0.0 0.0	000000000000000000000000000000000000000

Table A1-8. MRS-MPC (continued)

				A	10	8.71	5.8	0.2
J. Remove MPC Lift Attachment from MPC	30	20 15		Operators Ragman	10	8.7	22	0.1
		15		Crane Operator	20	0.5	0.1	0.1
A COLUMN AM CONTROL	10	5		Operators	2	394	6.6	0.0
k. Disengage Crane from MPC Lift Attachment	-	10		Ragman	10	8.7	1.5	0.0
		10	1	Crane Operator	20	0.5	0.1	0.0
* -t	210	155					129.0	1.0
Total								
Prep Loaded MPC/Storage-overpack from MPC					1_		لب	_
transfer cell to storage				assume crane enclosur		kgrou	AD COSE	
a. Remove Contamination Control From Loaded Storage C	20	20		Operators	2	<u>59</u>	39.3	0.3
b. Install Storage Cask Lid	60	30		Operators	2i 10i	97 8.7	97.0 4.4	0.1
		30		Ragman	20	0.5	0.3	0.1
		30		Crane Operator	2	97	97.0	0.3
		- 60		Welder Operators	6	- 11	1.8	0.0
c. Remove Platform Extension	5	5		Operator	0		0.0	0.0
cl. Open MPC Transfer Room Door, simultaneously with c.	10	10		Operator	10	8.7	1.5	0.0
d. Move Loaded Storage Cask to Storage Cask Prep Room	5	0		Operator	0	O	0.0	0.0
Ciose MPC Transfer Room Door	80	30		Radiation	2	59	59.0	0.3
1. HP Survey Cosk	20	10		Operators	2 j	59	19.7	0.1
g. Unsecure Loaded Storage Cask from Carrier		5		Operators	2	39.4	6.6	90
gl. Engage Crane with Yoke		10		Ragman	10	8.7	1.5	0.0
		10		Crane Operator	20	0.5	0.1	0.0
h. Open Storage Cask Prep Room Door	5	0		Operator	0	0	0.0	00
Open Storage Cask Prep Room Door Move Loaded Storage Cask to Transporter Bay	10	10		Operators	10	8.7	2.9	0.1
		10		Crone Operator	20	0.5	0.1	0.0
Disengage Crane from Loaded Storage Cask	10	10		Operators	2	39.A 8.7	13.1	0.1
j. Davingug		10		Ragman	20	0.5	0.1	-83
		10		Crane Operator	0	- 03	0.0	- 60
J. Close Storage Cask Prep Room, simuftaneous		0		Operator	2	- 5	59.0	0.3
k. Engage Loaded Storage Cask with Transporter	60	30		Operators Transporter Operator	15	0.5	0.3	0.1
		30 20	_	Operators	2	59	39.3	0.2
Id. Secure Loaded Storage Cask to Transporter for Moverno	20	30		Operators	10	8.7	8.7	0.0
Move Loaded Storage Cask to Storage yard	1 ~	80		Transporter Operator	15	0.5	0.5	0.0
(null background dose while moving)		30		Radiation Protection	10	8.7	44	0.0
	20	10		Operators	2	70	23.3	0.7
m. Unsecure Loaded Storage Cask from Transporter		20	1	Transporter Operator	15	0.5	0.2	0.7
	 	10		Radiation Protection	10	8.7	1.5	0.3
n. Place Loaded Storage Cask on Storage Pad	60	30	2	Operators	2	70	70.0	2.0
n. Place Loaded Storage Cask on Storage Foo		60	1	Transporter Operator	15	0.5	0.5	20
		10	1	Radiation Protection	10	8.7	1.5	0.3
o. Return Transporter to Transfer Facility	50			Operators	10	0	0.0	0.0
(unloaded & null brickground dose while moving)		50		Transporter Operator	15	0	0.0	<u>0.0</u>
CONSCIONATION		25		Rediction Protection	10	0	554.7	8.3
Total	475	740		ļ	-		334./	د.ه
	<u> </u>			assume ISFSI backgrou		**		
5. Prep Loaded MPC/Storage-overpack for MPC Transfer for	shipping		-	Operator	2	59	59.0	2.0
a. Engage Storage Cask with Transporter	60	30		Radiation Protection	2			1.0
	+	80		Transporter Operator	15			2.0
	20			Operators	2	59		1.3
b. Secure Storage Cask to Transporter	 	20	1	Radiation Protection	2	59	19.7	0.7
	 	20	 	Transporter Operator	15	0.5		0.7
c. Move Cask to Storage Cask Staging Area outside ISDSI	- 60			Operator	10	_		ΟC
c. Move Cask to Storage Cask stogetig Alect cutacte accer-	 	60		Rogman	10			0.0
(nuti dose background white moving)	1	60	1	Crane Operator	15			0.0
d. Unsecure Storage Cask from Transporter	20	20		Operators	2			0.2
d. Unsecure Storage Cask from transporter (assume crane enclosure background dose)		20		Radiation Protection	2			0.
MORE TO CHOICE DIXERUIS LIGHT CONTROL CONTROL				17	15	0.5		0.
(CESTILLIA CIGLIA AUCCOMA DOCKROOMS COOS)		20		Transporter Operator				ŏ
	10	20		Operator	2	39.4		חר ו
e. Engage Crane with Yoke to Storage Cask	10	20 5 10		Operator I Rogman	10	39.4 8.7	1.5	
e. Engage Crane with Yoke to Storage Cask		20 5 10		Operator Rogman Crane Operator	2 10 20	39.4 8.7 0.5	1.5 0.1	O.
	10	20 5 10 10 10) j	Operator I Rogman Crane Operator Operators	20 20 10	39.4 8.7 0.5 8.7	1.5 0.1 2.9	0.0
Engage Crane with Yoke to Storage Cask Move Storage Cask Into Storage Cask Prep Room	10	20)		Operator Rogman Crane Operator Operators Crane Operator	20 20 10 20	39.4 8.7 0.5 8.7	1.5 0.1 2.9 0.1	0.0 0.1
Engage Crane with Yoke to Storage Cask Move Storage Cask Into Storage Cask Prep Room Open Storage Cask Prep Room Door, simuffaneous	10	20 0 5 10 10 10) 5 0 0	Operator Rogman Crane Operator Operator Crane Operator	20 20 10	39.4 8.7 0.5 8.7 0.5	1.5 0.1 2.9 0.1	0. 0. 0.
Engage Crane with Yoke to Storage Cask Move Storage Cask Into Storage Cask Prep Room ft. Open Storage Cask Prep Room Door, simulfaneous g. Close Storage Cask Prep Room Door	10	20 30 30 30 30 30 30 30 30 30 30 30 30 30		Operator Rogman Crane Operator Operator Operator Operator	20 10 10 20 10 20	39.4 8.7 0.5 8.7 0.5	1.5 0.1 2.9 0.1 0.0 0.0	0. 0. 0.
Engage Crane with Yoke to Storage Cask Move Storage Cask Into Storage Cask Prep Room Den Storage Cask Prep Room Door, simuffaneous Close Storage Cask Prep Room Door h. HP Survey	10	20 5 10 10 10 10 5 6 5 2))))))	Operator Rogman Crane Operator Operator Crane Operator Operator Operator Operator	20 20 10 20 0	39.4 8.7 0.5 8.7 0.5 (1.5 0.1 2.9 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0. 0. 0. 0.
Engage Crane with Yoke to Storage Cask Move Storage Cask Into Storage Cask Prep Room 1. Open Storage Cask Prep Room Door, simultaneous g. Close Storage Cask Prep Room Door	10	20 30 30 30 30 30 30 30 30 30 30 30 30 30		Operator Rogman Crane Operator Operator Operator Operator	20 20 10 20 0 0	39.4 8.7 0.5 8.7 0.5 (0.5 (0.5 (0.5)	1.5 0.1 2.9 0.1 0.0 0.0 0.0 0.0 39.3 2.9 0.1	0.0 0.1 0.1 0.1 0.1 0.2
Engage Crane with Yoke to Storage Cask Move Storage Cask Into Storage Cask Prep Room 1. Open Storage Cask Prep Room Door, simuffaneous 9. Close Storage Cask Prep Room Door h. HP Survey i. Move Storage Cask to Carrier	10	20 10 10 10 10 10 10 10 10 10 10 10 10 10)))))))	Operator I Rogman I Crane Operator Operator I Crane Operator I Operator Operator Operator Operator Rodiation Protection Operator	20 20 10 20 0 0 0 20	39.4 8.7 0.5 0.5 () () () () () () () () () () () () ()	1.5 0.1 2.9 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 0.1 0.1 0.1 0.1 0.0
e. Engage Crane with Yoke to Storage Cask f. Move Storage Cask Into Storage Cask Prep Room fl. Open Storage Cask Prep Room Door, simuffaneous g. Close Storage Cask Prep Room Door h. HP Survey	4	20 10 10 10 10 10 10 10 10 10 10 10 10 10) 5 7 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	Operator Rogman Crane Operator Operator Crane Operator I Operator Operator Operator Rodiction Protection Operator	20 10 20 0 0 0 20 10 20	39.4 8.7 0.5 0.5 0.5 0.5 6 8.7 0.5 8.7 0.5 8.7 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	1.5 0.1 2.9 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1

						30.4	4.4	
ld. Disengage Crane with Yoke from Cask, simultaneous		10		Operator Crane Operator	10	39 <i>A</i> 8.7	66	<u> </u>
		10		Ragman	20	0.5	0.1	0.0
L Open MPC Transfer Room Door	5	5		Operator	10	8.7	0.7	O.
m. Move Cask to IMPC Transfer Room	45	45		Operator	10	8.7	6.5	0.2
THE MOVE CLER TO THE OTHER TOPS TO		45		Transporter Operator	20	0.5	0.4	0.2
m1, Close MPC Transfer Room Door, simulfaneous		5	1	Operator	0	0	0.0	0,0
n. Install Platform Extension	10	10	1	Operator	3	8.7	1.5	0.0
o Prep Cask for Opening	150	30		Operators	2	59	59.0	0.
		30		Radiation Protection	10	8.7	44	0.
		90		Welder	2	59	88.5	0,
p. Install Cask Lid Lifting Device	20	20		Operators	2	59	39.3	0.0
		10		Ragman	10 20	8.7 0.5	0.1	01
		10 15		Crane Operator Operators	2	97	48.5	0.
g. Remove Cask Lid	30	30		Operators	10	8.7	44	0.
		30		Operators	20	0.5	0.3	0.
- ID Consul	45	20		Radiation Protection	2	59	39.3	Ō.
r. HP Survey s. Install Contamination Control	20	20		Operators	2	59	39.3	0.2
Engage Crone MPC Lifting Attachment to MPC	36	25		Operators	2	39.4	32.8	0.2
1. Et gago ciciro tili O attigi viscolitico		20	1	Ragman	20	0.5	0.2	0.
		20		Crane Operator	20	0.5	02	0.
Total	655	1,105					708.7	11.
Receive and Prep Unloaded Transportation-overpack							od d	
for MPC transfer				assume crane enclosu		ckgrou 0	0.0	0.0
a. Inspect Bills of Lading, Other Shipping Papers	10	10		Operator Prime Mover Operator	0 15	9	0.0	0.0
b. Pull Cask into Security Area	5 40	5 		Security Officers	2	- 6	00	0.3
c. Security Inspection	30	30		Radiation Protection	2	ŏ	0.0	0.2
d. Perform HP Survey of Cask Externals	- 30	10		Operators	2	- 0	00	0.
e. Perform Local Decontamination(if needed)	80	- 60		Operators	2	0	0.0	0.5
Contain Contamination G. Take Cask to Protected Area Gate	10	10		Prime Mover Operator	15	0	0.0	0.0
h, Unhitch Off-Site Prime Mover	10	10		Prime Mover Operator	15	0	0.0	0.0
L Hitch Site Prime Mover	10	10	1	Prime Mover Operator	15	0	0.0	O.C
i. Take Cask to Receiving and Shipping Bay Door	10	10	1	Prime Mover Operator	15	0	0.0	<u>oc</u>
j1. Open Receiving and Shipping Bay Door; simultaneous		0	1	Operator	0	0	0.0	0.0
k. Take Cask into Receiving Bay	5	5		Operator	10	0	0.0	0.0
		5		Prime Mover Operator	15 15	0	0.0	-00
L Unhitch Site Prime Mover	10	10		Prime Mover Operator	0		- 60	0.0
11. Close Receiving and Shipping Bay Door, simultaneous		35		Operator Operators	2	0	00	0.3
m. Remover Personnel Barrier	35	35		Crane Operator	20	0	00	0.1
- 150 Communication	25	25		Radiation Protection	2	Ö	0.0	0.2
n. HP Survey o. Rope Off and Decontaminate Rail Car(if needec))	8	10		Operators	2	0	0.0	0.1
p. Remove impact Limiters	80	90		Operators	2	0	0.0	O.
p. Relibre intext Brass		90	1	Crane Operators	20	0	0.0	0.4
q. HP Survey of impact Limiter/Cask Intertace	10	10	2	Radiation Protection	2	0	0.0	0.
r. Decontaminate impact Limiter/Cask Interface(if needed)	.60	10	2	Operators	2	9	0.0	0.
s, Remove Tiedov/ns	50			Operators	2	0	0.0	0,
		53		Crane Operator	20			0:
t, Remove Trunnion Blocks	10			Operators	2		0.0	0.1
u. Attach Yoke to Crane	5			Operators	10		_	01
		5		Ragman Crane Operator	20		90	0,
No. 10 August Co. 1	5	5		Operators	2			0.
v. Engage Yoke to Cask		5		Ragman	10			0.0
		5		Crane Operator	20	_	0.0	0.
w. Open Prep Room Door	5			Operator	0		8	0.1
x. Move Cask into Transport Cask Prep Room Washdown Are				Operators	10			0.
N. HOLD GAME HAVE THE PARTY OF		10		Crane Operator	20			<u>Q</u>
y, Install Platform	10		1	Operator	6			0.
y1. Close Transport Cask Prep Room Door, simultaneous		0		Operator	0			0,
	30			Operators	2			0.
z. Washdown Cask	35			Radiation Protection	2			0.
z. Washdown Cask aa. HP Survey			4 Ì	Operator	10			0.
z. Washdown Cask aa. HP Survey bb. Remove Platform	5						, այ	
z. Washdown Cask aa. HP Survey		10	2	Operators	_		0.01	
z. Washdown Cask aa. HP Survey bb. Remove Platitorm cc. Move Transport Cask to Carrier	5 10	10 10	1	Crane Operator	20	0		
z. Washdown Cask aa. HP Survey bb. Remove Platform	5	10 10 30	1 2	Crane Operator Operators	20 10	0	0.0	0.
z. Washdown Cask aa. HP Survey bb. Remove Platitorm cc. Move Transport Cask to Carrier dd. Place Transport Cask on Carrier	5 10 30	10 10 30 30	1 2	Crane Operator Crane Operator	20 10 20	0	0.0 0.0	O. O.
z. Washdown Cask aa. HP Survey bb. Remove Platitorm cc. Move Transport Cask to Carrier dd. Place Transport Cask on Carrier ee. Secure Cask to Carrier	30 20	10 10 30 30 20	2 1 2 1	Crane Operator Crane Operator Operator	20 10	0	QQ QQ QQ	
z. Washdown Cask aa. HP Survey bb. Remove Platitorm cc. Move Transport Cask to Carrier dd. Place Transport Cask on Carrier	30 20	10 10 30 30	1 2 1 2 1	Crane Operator Crane Operator	20 10 20 2	0 0 0	0.0 0.0 0.0 0.0	0. 0. 0.

					~	~ ~	0.0	Q
ff. Open MPC Transfer Room Door	5	5		Operators	10	9	- 000	-8
gg. Move Cask Carrier into MPC Transfer Room	45	45		Operators	0	o	00	0
agil. Clase MPC Transfer Room Door, simultaneous	1	0		Operator			60	- 0 .
ill. Install Platform Extension, simultaneously with ii.		10		Operators	6	0		
kk. Install Cask Lid Lifting Device	20	20		Operators	2	0	0.0	0.
	1	20	1	Ragman	10	0	0.0	0.
		20		Crane Operato:	20	0	0.0	0.
T. Lawrence Control lid	60	60	2	Operators	2	0	0.0	0.
I. Loosen/Remove Cask Lid	 	60		Raaman	10	0	0.0	0.
	 	- 60		Crane Operator	20	o	0.0	0.
		10		Operators	2	ŏ	0.0	0.
mm. Install Contamination Control	10				2	- 6	0.0	- 0
nn. Engage MPC Crane Lifting Attachment to the MPC	35	35		Operators				
	Ĺ	35		Ragman	10	0	0.0	0.
		35	1	Crane Operator	20	0	0.0	0.
Total	940	1,305					0	8.3
JOIG!								
sa. Cut open MPC (not included in any routine operation e	dimotes)							
C. Curopen Mrc (not sectors in any rossis) operation	3,375	435					1,121	
7. Transfer MPC from Storage-overpack to					$-\!\!\!+$			
Transportation-overpack (assume in ISFSI area)				assume ISPSI initially				
a. Engage Crane to MPC Lift Attachment	10	5		Operators	2	39.4	3.3	0.
a. migrapo signo is a since	1	10	1	Ragman	10	11	1.8	0
	1	10		Crane Operator	20	0.5	0,1	0
	10	10		Operator	2	97	162	Ö
b. Verify Vertical Alignment of MPC to Storage Cask		0		Operators	0	- 0	0.0	ō
c. Clear Operators to a Shielded Area	5				0	- 0	00	_ 0
c1. Close Transfer Room Doors	1	0		Operator	0	- 0	00	-6
d. Rake MPC from Storage Cask	30	0		Remote				-8
e. Move MPC Over Transport Cask	5	0	0	Remote	0	0	0.0	_
f. Verify Vertical Alignment of MPC to Transport Cask	10	0	0	Remote	0	0	0.0	0
I. Verry Verrical Algorithms of the City Manager	20	0	0	Remote	0	0	0.0	0
g. Correct Vertical Alignment	30	0		Remote	0	0	0.0	0.
h. Lower MPC into Transport Cask	1 30			Remote	ō	O	0.0	0
h1. Open Transfer Room Doors	 	0			2	43	143	ō
i. Radiction and Contamination Survey	10	10		Radiation Protection			46.7	1
j. Remove MPC Lift Attachment from MPC	30	20		Operators	2	70.0		
		15		Ragman	10	8.7	2.2	0.
		15	1	Crane Operator	20	0.5	0.1	0
k. Disengage Crane from MPC Lift Attachment	10	5	1	Operators	2	39.4	3.3	0.
K Disengage Clarie florities Clari Articus		10		Ragman	10	8.7	1.5	0
	 	10		Crane Operator	20	0.5	0.1	0
	170			O.G. O DO G. G. G.			89.5	5
Tatal	1 1/0	120	-					
	+	ļ						
8. Prep Unloaded Storage-overpack from MPC	1							
Imposier Cell to Storage Yard			 				المنافحة المح	46.
				assume crane enciosu			nd initic	ylk
a Perrove Contamination Control from Unloaded Storage	20	20		Operators	2	0	0.0	0
a. Remove Contamination Control from Unloaded Storage	20				2	0 0	0.0 0.0	0
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Lid	20		2	Operators	2	0 0	0.0	0
a. Remove Contamination Control from Unloaded Storage	20 60	60	2	Operators Operators Ragmen	2	0 0	0.0 0.0	0
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd	- au	60	2	Operators Operators Ragmen Crane Operator	2 10 20	0 0	0.0 0.0	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd Remove Platform Extension	5	60 60 60	1 1	Operators Operators Rogman Crane Operator Operators	2 10 20 6	0 0 0	0.0 0.0 0.0 0.0	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd c. Remove Platform Extension c.1. Onen MPC Transfer Room Door, simultaneously with a	5 c. 5	60 60 60	2	Operators Operators Ragman Crane Operator Operator Operator	2 10 20 6	0 0 0 0	0.0 0.0 0.0 0.0 0.0	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd c. Remove Platform Extension c.1. Onen MPC Transfer Room Door, simultaneously with a	5 c 5 m 10	60 60 60 60	2 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Operators Operators Regman Crane Operator Operator Operator Operator Operator	2 10 20 6 0	00000	0.0 0.0 0.0 0.0 0.0	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd c. Remove Platform Edension cl. Open MPC Transfer Room Door, simultaneously with a d. Move Unloaded Storage Cask to Storage Cask Prep Room	5 c. 5 m 10	60 60 60 5	2 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Operators Operators Rogman Crane Operator Operators Operator Operators Operators Operator	2 10 20 6 0	0 0 0	0.0 0.0 0.0 0.0 0.0 0.0 0.0	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd c. Remove Platform Edension cl. Open MPC Transfer Room Door, simultaneously with a d. Move Unloaded Storage Cask to Storage Cask Prep Room e. Close MPC Transfer Room Door	5 c 5 m 10	60 60 60 5	2 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Operators Operators Regman Crane Operator Operator Operator Operator Operator	2 10 20 6 0 10	0 0 0 0 0 0	0.0 0.0 0.0 0.0 0.0 0.0 0.0	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Lid c. Remove Platform Extension c1. Open MPC Transfer Room Door, simultaneously with a d. Move Unloaded Storage Cask to Storage Cask Prep Root e. Close MPC Transfer Room Door 1. HP Survey Cask	5 c. 5 m 10	60 60 60 5 10	2 1 1 1 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3	Operators Operators Rogman Crane Operator Operators Operator Operators Operators Operator	2 10 20 6 0	0 0 0 0 0 0 0	00 00 00 00 00 00 00 00 00	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd c. Remove Platform Edension cl. Open MPC Transfer Room Door, simultaneously with a d. Move Unloaded Storage Cask to Storage Cask Prep Room e. Close MPC Transfer Room Door	5 C 5 m 10	60 60 60 5 10	2 1 1 1 2 3 3 1 1 2 3 3 1 1 2 1 1 1 1 1	Operators Operators Rogman Crane Operator Operator Operator Operator Operator Poperator Radiation Protection	2 10 20 6 0 10	0 0 0 0 0 0	00 00 00 00 00 00 00 00 00	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Lid c. Remove Platform Extension c1. Open MPC Transfer Room Door, simultaneously with a d. Move Unloaded Storage Cask to Storage Cask Prep Root e. Close MPC Transfer Room Door 1. HP Survey Cask	5 C 5 m 10	60 60 60 5 5 10 10 45 45	22 11 13 13 13 14 15 15 15 15 15 15 15 15 15 15 15 15 15	Operators Operators Ragman Crane Operator Operators Operator Operators Operator Radication Protection Operator Radication	2 10 20 6 0 10 0	0 0 0 0 0 0 0 0 0	00 00 00 00 00 00 00 00 00 00 00	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd c. Remove Platform Edension c1. Open MPC Transfer Room Door, simultaneously with a d. Move Unloaded Storage Cask to Storage Cask Prep Roor e. Close MPC Transfer Room Door 1. HP Survey Cask g. Engage Crane with Yoke to Storage Cask	5 c. 5 m 10 5 45	60 60 60 5 5 10 5 45 10 10	22 1 1 1 2 2 3 3 2 3 1 1 2 3 3 3 3 3 3 3	Operators Operators Ragmen Crane Operator Operators Operator Operator Operator Radiation Protection Operator Ragman Crane Operator	2 20 20 6 0 10 0 22 2 10 20	0 0 0 0 0 0 0 0 0 0	60 60 60 60 60 60 60 60 60 60 60	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Lid c. Remove Platform Extension c1. Open MPC Transfer Room Door, simultaneously with a d. Move Unloaded Storage Cask to Storage Cask Prep Root e. Close MPC Transfer Room Door 1. HP Survey Cask	5 c. 5 m 10 5 45	60 60 60 5 5 10 5 46 10 10	2 1 1 1 1 1 2 2 3 3 1 1 1 2 3 3 1 1 1 1	Operators Operators Rogman Crane Operator Operator Operator Operator Rodication Protection Operator Ragman Crane Operator	2 10 20 6 0 10 0 2 2 10 20 20 20	000000000000000000000000000000000000000	80 80 80 80 80 80 80 80 80	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd c. Remove Platform Extension c1. Open MPC Transfer Room Door, simultaneously with a d. Move Unloaded Storage Cask to Storage Cask Prep Root e. Close MPC Transfer Room Door f. HP Survey Cask g. Engage Crane with Yoke to Storage Cask g1. Unsecure Unloaded Storage Cask from Carrier, simul	55 55 m 100 55 455 100 100 100 100 100 100 100 100 100 1	60 60 60 5 5 10 5 46 10 10 10 30 30		Operators Operators Rogman Crane Operator Operators Operator Operator Rodication Protection Operator Ragman Crane Operator Operator	2 20 20 6 0 10 0 2 2 10 20 20 20	000000000000000000000000000000000000000	60 60 60 60 60 60 60 60 60 60 60	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd c. Remove Platform Extension c1. Open MPC Transfer Room Door, simultaneously with a d. Move Unloaded Storage Cask to Storage Cask Prep Room e. Close MPC Transfer Room Door f. HP Survey Cask g. Engage Crane with Yoke to Storage Cask g1. Unsecure Unloaded Storage Cask from Carrier, simultaneously h. Open Storage Cask Prep Room Door	5 5 5 m 100 5 45 100 100 100 100 100 100 100 100 100 10	60 60 50 5 10 10 10 10 30 30	2 1 1 1 1 1 2 2 3 3 3 3 3 3 3 3 3 3 3 3	Operators Operators Rogman Crane Operator Operator Operator Operator Padiation Protection Operator Radiation Protection Operator Rogman Crane Operator Operator Crane Operator Operator Operator	2 10 20 6 0 10 0 2 2 10 20 20 20		3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd c. Remove Platform Extension c1. Open MPC Transfer Room Door, simultaneously with a d. Move Unloaded Storage Cask to Storage Cask Prep Room e. Close MPC Transfer Room Door f. HP Survey Cask g. Engage Crane with Yoke to Storage Cask g1. Unsecure Unloaded Storage Cask from Carrier, simultaneously h. Open Storage Cask Prep Room Door	55 55 m 100 55 455 100 100 100 100 100 100 100 100 100 1	60 60 5 5 10 10 10 10 30 30 30 10		Operators Operators Rogman Crane Operator Operator Operator Operator Radiation Protection Operator Radiation Protection Operator Rogman Crane Operator Operator Operator Operator Operator	2 20 20 6 0 10 0 20 20 20 20 0		33 33 33 33 33 33 33 33 33 33 33 33 33	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd c. Remove Platform Extension c1. Open MPC Transfer Room Door, simultaneously with a d. Move Unloaded Storage Cask to Storage Cask Prep Root e. Close MPC Transfer Room Door f. HP Survey Cask g. Engage Crane with Yoke to Storage Cask g1. Unsecure Unloaded Storage Cask from Carrier, simul	55 5 5 5 7 10 10 10 10 10 10 10 10 10 10 10 10 10	60 60 60 5 5 10 10 10 10 30 30 30 10		Operators Operators Rogman Crane Operator Operator Operator Operator Operator Radiation Protection Operator Radiation Protection Operator Rogman Crane Operator Operator Operator Operator Operator Operator Operator Operator	2 10 20 0 0 10 2 2 10 20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	000000000000000000000000000000000000000	88 88 88 88 88 88 88 88 88 88 88 88 88	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd c. Remove Platform Edension c1. Open MPC Transfer Room Door, simultaneously with of d. Move Unloaded Storage Cask to Storage Cask Prep Roor e. Close MPC Transfer Room Door 1. HP Survey Cask g. Engage Crane with Yoke to Storage Cask g1. Unsecure Unloaded Storage Cask from Carrier, simult h. Open Storage Cask Prep Room Door I. Move Unloaded Storage Cask to Transporter Bay	5 5 5 m 100 5 45 100 100 100 100 100 100 100 100 100 10	60 60 60 5 5 10 10 10 10 30 30 30 10		Operators Operators Rogman Crane Operator Operator Operator Operator Radiation Protection Operator Radiation Protection Operator Rogman Crane Operator Operator Operator Operator Operator	2 10 20 0 0 10 0 2 10 20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	000000000000000000000000000000000000000	88 88 88 88 88 88 88 88 88 88 88 88 88	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Lid c. Remove Platform Extension c1. Open MPC Transfer Room Door, simultaneously with a d. Move Unloaded Storage Cask to Storage Cask Prep Room e. Close MPC Transfer Room Door f. HP Survey Cask g. Engage Crane with Yoke to Storage Cask g1. Unsecure Unloaded Storage Cask from Carrier, simultaneously h. Open Storage Cask Prep Room Door	55 5 5 5 7 10 10 10 10 10 10 10 10 10 10 10 10 10	60 60 60 5 5 10 10 10 10 30 30 30 10	2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Operators Operators Rogman Crane Operator Operator Operator Operator Operator Radiation Protection Operator Radiation Protection Operator Rogman Crane Operator Operator Operator Operator Operator Operator Operator Operator	20 20 0 0 0 10 2 2 10 2 2 2 2 2 0 10 2 2 2 2	000000000000000000000000000000000000000	60 60 60 60 60 60 60 60 60 60 60 60 60 6	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Lid c. Remove Platform Edension c1. Open MPC Transfer Room Door, simultaneously with 6 d. Move Unloaded Storage Cask to Storage Cask Prep Roor e. Close MPC Transfer Room Door f. HP Survey Cask g. Engage Crane with Yoke to Storage Cask g1. Unsecure Unloaded Storage Cask from Carrier, simultaneously Valley h. Open Storage Cask Prep Room Door i. Move Unloaded Storage Cask to Transporter Bay j. Engage Unloaded Storage Cask with Transporter	55 5 5 5 7 10 10 10 10 10 10 10 10 10 10 10 10 10	60 60 60 5 5 7 10 10 10 10 10 10 10 10 10 10 10 10 10	2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Operators Operators Ragman Crane Operator Operator Operator Operator Operator Operator Radiation Protection Operator Rogman Crane Operator Operator Operator Crane Operator	2 10 20 0 0 10 0 2 10 20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	000000000000000000000000000000000000000	60 60 60 60 60 60 60 60 60 60 60 60 60 6	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Lid c. Remove Platform Edension c1. Open MPC Transfer Room Door, simultaneously with 6 d. Move Unloaded Storage Cask to Storage Cask Prep Roor e. Close MPC Transfer Room Door f. HP Survey Cask g. Engage Crane with Yoke to Storage Cask g1. Unsecure Unloaded Storage Cask from Carrier, simultaneously h. Open Storage Cask Prep Room Door L. Move Unloaded Storage Cask to Transporter Bay j. Engage Unloaded Storage Cask with Transporter	5 5 5 5 7 10 10 10 10 10 10 10 10 10 10 10 10 10	60 60 60 5 5 10 10 10 10 30 30 5 10 10 10 10 10 10 10 10 10 10 10 10 10		Operators Operators Rogman Crane Operator Operators Operator Operator Operator Radication Protection Operator Radication Protection Operator Rogman Crane Operator Operators Crane Operator	20 20 0 0 0 10 2 2 10 2 2 2 2 2 0 10 2 2 2 2	000000000000000000000000000000000000000	80 80 80 80 80 80 80 80 80 80 80 80 80 8	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd c. Remove Platform Edension c1. Open MPC Transfer Room Door, simultaneously with of Move Unloaded Storage Cask to Storage Cask Prep Room d. Move Unloaded Storage Cask to Storage Cask Prep Room e. Close MPC Transfer Room Door f. HP Survey Cask g. Engage Crane with Yoke to Storage Cask g1. Unsecure Unloaded Storage Cask from Carrier, simultaneous h. Open Storage Cask Prep Room Door i. Move Unloaded Storage Cask to Transporter Bay j. Engage Unloaded Storage Cask with Transporter Jl. Close Storage Cask Prep Room Door, simultaneous k. Secure Unloaded Storage Cask to Transporter for Movee	5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	60 60 60 5 5 10 10 10 10 10 10 10 10 6 6 6 6 6 7 10 10 10 10 10 10 10 10 10 10 10 10 10	2	Operators Operators Rogman Crane Operator Operator Operator Operator Operator Radication Protection Operator Ragman Crane Operator	2 2 2 10 10 10 10 10 10 10 10 10 10 10 10 10	000000000000000000000000000000000000000	88 88 88 88 88 88 88 88 88 88 88 88 88	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Lid c. Remove Platform Edension c1. Open MPC Transfer Room Door, simultaneously with 6 d. Move Unloaded Storage Cask to Storage Cask Prep Roor e. Close MPC Transfer Room Door f. HP Survey Cask g. Engage Crane with Yoke to Storage Cask g1. Unsecure Unloaded Storage Cask from Carrier, simultaneously h. Open Storage Cask Prep Room Door L. Move Unloaded Storage Cask to Transporter Bay j. Engage Unloaded Storage Cask with Transporter	5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	60 60 5 5 10 10 10 10 10 10 10 10 10 10 10 10 10		Operators Operators Rogman Crane Operator Operator Operator Operator Protection Operator Radiation Protection Operator Radiation Protection Operator Rogman Crane Operator Operator Operator Crane Operator	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	000000000000000000000000000000000000000	60 60 60 60 60 60 60 60 60 60 60 60 60 6	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd c. Remove Platform Edension c1. Open MPC Transfer Room Door, simultaneously with of Move Unloaded Storage Cask to Storage Cask Prep Room d. Move Unloaded Storage Cask to Storage Cask Prep Room e. Close MPC Transfer Room Door f. HP Survey Cask g. Engage Crane with Yoke to Storage Cask g1. Unsecure Unloaded Storage Cask from Carrier, simultaneous h. Open Storage Cask Prep Room Door i. Move Unloaded Storage Cask to Transporter Bay j. Engage Unloaded Storage Cask with Transporter Jl. Close Storage Cask Prep Room Door, simultaneous k. Secure Unloaded Storage Cask to Transporter for Movee	5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	600 600 600 600 600 600 600 600 600 600		Operators Operators Regman Regman Operator Operator Operator Operator Operator Rediction Protection Operator Rediction Protection Operator Rediction Operator Income Operator	2 2 2 1 10 1 20 1 20 1 20 2 2 2 2 2 2 2	000000000000000000000000000000000000000	88 88 88 88 88 88 88 88 88 88 88 88 88	
a. Remove Confamination Control from Unloaded Storage b. Install Storage Cask Ltd c. Remove Platform Edension c1. Open MPC Transfer Room Door, simultaneously with of Move Unloaded Storage Cask to Storage Cask Prep Room e. Close MPC Transfer Room Door f. HP Survey Cask g. Engage Crane with Yoke to Storage Cask from Carrier, simultaneously g1. Unsecure Unloaded Storage Cask from Carrier, simultaneous h. Open Storage Cask Prep Room Door i. Move Unloaded Storage Cask to Transporter Bay j. Engage Unloaded Storage Cask with Transporter j1. Close Storage Cask Prep Room Door, simultaneous k Secure Unloaded Storage Cask to Transporter for Move	5 5 5 7 10 10 10 10 10 10 10 10 10 10 10 10 10	600 600 600 600 600 600 600 600 600 600		Operators Operators Ragman Crane Operator Operator Operator Operator Operator Radiation Protection Operator Radiation Protection Operator Radiation Operator Operator Operator Crane Operator	2 2 2 10 10 10 10 10 10 10 10 10 10 10 10 10	000000000000000000000000000000000000000	60 60 60 60 60 60 60 60 60 60 60 60 60 6	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd c. Remove Platform Edension c1. Open MPC Transfer Room Door, simultaneously with 6 d. Move Unloaded Storage Cask to Storage Cask Prep Room e. Close MPC Transfer Room Door f. HP Survey Cask g. Engage Crane with Yoke to Storage Cask from Carrier, simultaneously with 6 h. Open Storage Cask Prep Room Door L. Move Unloaded Storage Cask to Transporter Bay j. Engage Unloaded Storage Cask with Transporter j. Engage Unloaded Storage Cask with Transporter K. Secure Unloaded Storage Cask to Transporter for Movee kt. Disengage Crane from Unloaded Storage Cask, simultaneous kt. Disengage Crane from Unloaded Storage Cask, simultaneous kt. Disengage Crane from Unloaded Storage Cask, simultaneous	5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	600 600 600 600 600 600 600 600 600 600	2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	Operators Operators Ragman Crane Operator Operator Operator Operator Operator Operator Operator Radiation Protection Operator Radiation Protection Operator Rogman Crane Operator I Crane Operator Operator I Operator	2 2 2 2 2 2 2 2 2 2	000000000000000000000000000000000000000	60 60 60 60 60 60 60 60 60 60 60 60 60 6	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd c. Remove Platform Extension c1. Open MPC Transfer Room Door, simultaneously with 6 d. Move Unloaded Storage Cask to Storage Cask Prep Room e. Close MPC Transfer Room Door f. HP Survey Cask g. Engage Crane with Yoke to Storage Cask from Carrier, simultaneously with 6 g1. Unsecure Unloaded Storage Cask from Carrier, simultaneous Lindowe Unloaded Storage Cask to Transporter Bay j. Engage Unloaded Storage Cask with Transporter j. Close Storage Cask Prep Room Door, simultaneous k. Secure Unloaded Storage Cask to Transporter for Movee k1. Disengage Crane from Unloaded Storage Cask, simultaneous L. Move Unloaded Storage Cask to Storage Cask, simultaneous L. Move Unloaded Storage Cask to Storage Cask, simultaneous L. Move Unloaded Storage Cask to Storage Cask, simultaneous L. Move Unloaded Storage Cask to Storage Cask, simultaneous L. Move Unloaded Storage Cask to Storage Cask, simultaneous L. Move Unloaded Storage Cask to Storage Cask, simultaneous L. Move Unloaded Storage Cask to Storage Cask, simultaneous L. Move Unloaded Storage Cask to Storage Varid	5 5 5 7 10 10 10 10 10 10 10 10 10 10 10 10 10	600 600 600 600 600 600 600 600 600 600	2 2 3 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	Operators Operators Ragman Crane Operator Operator Operator Operator Operator Radiation Protection Operator Radiation Protection Operator Radiation Operator Operator Operator Crane Operator	2 2 10 10 10 10 10 10 10 10 10 10 10 10 10	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	60 60 60 60 60 60 60 60 60 60 60 60 60 6	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Ltd c. Remove Platform Edension c1. Open MPC Transfer Room Door, simultaneously with 6 d. Move Unloaded Storage Cask to Storage Cask Prep Room e. Close MPC Transfer Room Door f. HP Survey Cask g. Engage Crane with Yoke to Storage Cask from Carrier, simultaneously with 6 h. Open Storage Cask Prep Room Door L. Move Unloaded Storage Cask to Transporter Bay j. Engage Unloaded Storage Cask with Transporter j. Engage Unloaded Storage Cask with Transporter K. Secure Unloaded Storage Cask to Transporter for Movee kt. Disengage Crane from Unloaded Storage Cask, simultaneous kt. Disengage Crane from Unloaded Storage Cask, simultaneous kt. Disengage Crane from Unloaded Storage Cask, simultaneous	5 5 5 7 10 10 10 10 10 10 10 10 10 10 10 10 10	600 600 600 600 600 600 600 600 600 600	2 2 3 3 3 3 3 3 3 3	Operators Operators Ragman Crane Operator Operators Operator Operator Operator Radication Protection Operator Radication Protection Operator Radication Crane Operator I Crane Operator Operator Operator Operator I Crane Operator Operator I Crane Operator Operator Operator I Operator	2 2 2 2 2 2 2 2 2 2	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	60 60 60 60 60 60 60 60 60 60 60 60 60 6	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Lid c. Remove Platform Edension c1. Open MPC Transfer Room Door, simultaneously with a d. Move Unloaded Storage Cask to Storage Cask Prep Roor e. Close MPC Transfer Room Door f. HP Survey Cask g. Engage Crane with Yoke to Storage Cask g1. Unsecure Unloaded Storage Cask from Carrier, simultaneous Unloaded Storage Cask from Carrier, simultaneous Unloaded Storage Cask to Transporter Bay j. Engage Unloaded Storage Cask with Transporter j1. Close Storage Cask Prep Room Door k. Secure Unloaded Storage Cask to Transporter for Movel k1. Disengage Crane from Unloaded Storage Cask, simultaneous L. Move Unloaded Storage Cask to Storage Cask, simultaneous L. Move Unloaded Storage Cask to Storage Cask, simultaneous L. Move Unloaded Storage Cask to Storage Yaid (null background while moving)	5 5 5 5 m 100 5 5 100 100 100 100 100 100 100 100	600 600 600 600 600 600 600 600 600 600	2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	Operators Operators Ragman Crane Operator Operators Operator Operator Operator Radication Protection Operator Radication Protection Operator Ragman Crane Operator Operators Crane Operator Operators Crane Operator Operators Crane Operator Operators I Crane Operator Operators I Crane Operator Operators I Crane Operator Operators I Crane Operator	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	000000000000000000000000000000000000000	60 60 60 60 60 60 60 60 60 60 60 60 60 6	
a. Remove Contamination Control from Unloaded Storage b. Install Storage Cask Lid c. Remove Platform Extension c1. Open MPC Transfer Room Door, simultaneously with 6 d. Move Unloaded Storage Cask to Storage Cask Prep Room e. Close MPC Transfer Room Door f. HP Survey Cask g. Engage Crane with Yoke to Storage Cask from Carrier, simultaneously with 6 g1. Unsecure Unloaded Storage Cask from Carrier, simultaneous Lindousled Storage Cask to Transporter Bay j. Engage Unloaded Storage Cask with Transporter j. Close Storage Cask Prep Room Door, simultaneous k. Secure Unloaded Storage Cask to Transporter for Movee k1. Disengage Crane from Unloaded Storage Cask, simultaneous L. Move Unloaded Storage Cask to Storage Cask, simultaneous L. Move Unloaded Storage Cask to Storage Cask, simultaneous L. Move Unloaded Storage Cask to Storage Cask, simultaneous L. Move Unloaded Storage Cask to Storage Cask, simultaneous L. Move Unloaded Storage Cask to Storage Yard	5 5 5 7 10 10 10 10 10 10 10 10 10 10 10 10 10	600 600 600 600 600 600 600 600 600 600		Operators Operators Ragman Crane Operator Operators Operator Operator Operator Radication Protection Operator Radication Protection Operator Radication Crane Operator I Crane Operator Operator Operator Operator I Crane Operator Operator I Crane Operator Operator Operator I Operator	22 20 00 00 00 22 20 20 20 20 20 20 20 2	000000000000000000000000000000000000000	60 60 60 60 60 60 60 60 60 60 60 60 60 6	

n. Place Unloaded Storage Cask on Storage Pad	60	60	2	Operators	2	0		40
		60	1	Transporter Operator	15	0		20
		60		Radiation Protection	10	0	8	2.0
Cod Town and to Agree the Conflict	50			Operators	10	0	00	0.0
o. Return Transporter to Transfer Facility	 3 0				15	0		00
(nut background white moving)	<u> </u>	50		Transporter Operator				
		50	1	Radiation Protection	10	0	0.0	0.0
Total	455	1,125			1 1		0.0	14.0
		101						
9. Prep MPC/Transportation-overpack from		<u> </u>			لبا		لببا	
MPC Transfer Cell for Shipping	<u> </u>	L	<u> </u>	assume crane enclosu				
a. Remove Contamination Control	20	20	2	Operators	2	43	28.7	0.2
b, Inspect MPC Transportation Cask Seal Surfaces	40	20	2	Operators	2	43	28.7	0.2
	30	30		Operators	2	70	70.0	0.3
c. Install Cask Ud	30							0.1
		20		Ragman	10	8.7	2.9	
	l	20		Crane Operator	20	0.5	02	0.1
d. Remove Platform Extension	5	5	1	Operator	6	8.7	0.7	90
C. Religious Franchis Construction Construct		Ö		Operator	O	0	ao	0.0
d1. Open MPC Transfer Room Door, simultaneous		_						
e. Move Transport Cask into MPC Transportation Cask Prep I	10	10	_	Operator	10	8.7	1.5	0.0
e1. Close MPC Transportation Room Door, simultaneous	1	0	1	Operator	0	0	0.0	.00
f. Unsecure Cask from Carrier	10	10	2	Operators	2	43	143	0.1
I. DIDECTE CAR HOLD CARE		10		Operator	2	- 17	2.8	0.0
 Engage Crane with Yoke to Transport Cask, struitaned 	<u> </u>							
	L	10		Ragman	10	8.7	1.5	0.0
		10	1	Crane Operator	20	0.5	0.1	0.0
g. Move Transport Cask to Washdown	10	10		Operators	10	8.7	2.9	0.1
9. MOVE HEIBPOH CASK TO PROSTOCIONAL	"			The second secon	20	0.5	0.1	0.0
		10		Crane Operator	_			
h. Install Platform	10	10		Operator	6	8.7	1.5	0.0
L Deconfaminate Cask	180	180	ī	Operator	6	8.7	26.1	0.8
		20		Radiation Protection	2	43	28.7	02
J. HP Survey	40						0.7	0.0
k. Remove Pictform	5	5		Operator	6	8.7		
k1. Open MPC Transportation Cask Prep Room Door, simultar	neois	0	1	Operator	0	0	0.0	0.0
L Move Transport to Receiving and Shipping	10	10	2	Operator	2	8.7	2.9	0.1
L MOVE HORSPOIL TO RECEIVING CITED SHIPPEN				Crane Operator	20	0.5	0.1	0.0
	<u></u>	10						_
 Close MPC Transportation Cask Prep Room Door, simultane 	BOUS	0	_1	Operator	0	<u> </u>	0.0	0.0
m. Lift Cask onto Rali Car	40	49	2	Operator	10	1.8	24	0.3
TIL DIT COR CHO KO CO		40		Crane Operator	20	0.5	0.3	0.2
					2	17	14	0.0
n. Disengage Yola)	10	5		Operator				
		10	1	Ragman	10	8.7	1.5	ឈ
		10		Crane Operator	20	0.5	0.1	0.0
to a section of the s	20	20		Operators	2	32	21,3	0.2
o. Install Trunnion Blocks	<u> </u>				20	0.5	02	0.1
		20		Crane Operator				
p. HP Survey	70	70	2	Radiation Protection	2	43	100.3	۵.6
		70	1	Prime Mover Operator	15	0.5	0.6	2
		70		Crane Operator	20	05	0.6	23
					2	43	50.2	23
		70		Radiation Protection				
g. Install Cask Restraints	70	70	2	Operators	2	43	100.3	47
		70	1	Prime Mover Operator	15	0.5	0.6	23
	 	70		Crane Operator	20	0.5	0.6	23
	 			Radiation Protection	10	8.7	102	23
	 	70						
r. Install Impact Limiters	110	110		Operators	2	43	157.7	7.3
	1	110	1	Prime Mover Operator	15	0.5	0.9	3.7
	 	110		Crane Operator	20	0.5	0.9	3.7
	 						16.0	-
		110		Radiation Protection	10	8.7		37
s, Install Personnel Barrier	35	35	2	Operators	2	43	50.2	2.3
	T	35	1	Prime Mover Operator	15	0.5	0.3	12
		35		Crane Operator	20	0.5	0.3	12
<u></u>	 				10	8.7	5.1	1.2
	<u> </u>	35		Radiation Protection				
s1. Open Receiving and Shipping Bay Door, simultaneous	<u></u>	0		Operator	0	0	0.0	8
1. Hitch Site Prime Mover	10	10	ī	Prime Mover Operator	15	0.5	0.1	0.0
	20			Operator	0	0	0.0	0.0
11. Prepare Shipping Paperwork, simultaneous				Prime Mover Operator		0.5	0.1	0.0
u. Move Cask to Protected Area Gate	10							
v. Unhitch Site Prime Mover	5	5		Prime Mover Operator		0.5	0.0	0.0
k: Hitch Off-Site PM	5	5	2	Operators	10	8.7	1.45	
	1	5		Prime Mover Operator	15	0.5	0.04	
		1,730	-				736.2	46.6
Total	 	1,,30			 			
					لببا		 	
10. Receive Empty MPC (see slep 2)	280	0		assume nuli backgrou	nd do	149	0.0	4.7
	 			assume null backgroui	74.4~	6 2		
		0		THE PARTY OF THE PARTY OF	~~~			- 4
11. Receive Unloaded Transportation- or		. n					۵۵	8.4
11. Receive Unloaded Transportation- or Storage-overpack (see step 6)	400							
	400				<u></u> ;		L1	
Storage-overpack (see step 6)			_	assume null backgrou	no da	\$ \$	0.0	1.9
	180			assume null backgrout	no do	s o	0.0	1.9
Storage-overpack (see step 6) 12. Load MPC Into Overpack (see step 13)				assume null backgroun	no do	19	0.0	1.9
Storage-overpack (see step 6)				assume null backgroui				1.9

	1 10	10	316	Operator	6	О	0.0	00
a, install Platform	10	10		Operator	2	0	0.0	00
b. Engage Crane to MPC Lift Attachment	10	10	_	Ragman	10	ō	0.0	00
		10		Crane Operator	20	ö	00	0.0
	<u> </u>			Operators	10	-	100	0.1
c. Move MPC Over Storage Cask	10	10			20	히	0.0	00
		10		Crone Operator		- 히	0.0	<u>~~~</u>
d. Vertify Vertical Alignment of MPC to Storage Cask	10	10		Operator	10	~~	00	- 66
V		10		Ragman .				_
		10	1	Crane Operator	20	0	0.0	0.0
f. Lower MPC into Storage Cosk	30	30	- 1	Operator	2	0	0.0	0.1
T. LOWER MPC THIS SIGNAGE COSK		30	1	Rogman	10	0	0.0	0.1
		30		Crane Operator	20	0	0.0	0.1
	10	10		Operator	2	0	0.0	0.0
g. Disengage MPC Lifting Attachment	 	10		Ragman	10	0	0.0	0.0
	├	10		Crane Operator	20	0	0.0	0.0
	 				2	ō	0.0	0.1
h, install a Spacer	10	10		Operators	20	0	0.0	0.0
		10		Crane Operator	2	- 8	0.0	0.3
L Place MPC Shield Plug	30	30		Operators			0.0	0.1
LTIOCO IIII O ULUS III	T	30		Rogman	10	0		_
		30		Crane Operator	20	0	0.0	C.1
The same state of the same sta	10	10	2	Operators	2	0	0.0	0.1
j. Attach interface Fixture	10	10	1	Operator	6	0	0.0	0.0
k. Remove Platform	30	30		Remote	0	0	0.0	0.0
I. Move Storage Cask Under Cell Port	30	30		Remote	0	0	0.0	0.0
m. Mate Storage Cask to Cell Port				Operators	2	ō	0.0	0.1
n. Remove Port Plug and MPC Shield Plug	15	15			10	ŏ	0.0	0.1
		15		Rogman	20	0	00	C.1
	11	15		Crane Operator	<u> עב</u>	-4	0.0	1.9
Total	215	445	i				<u> </u>	1.7
TOTAL							+	
14. Load SNF into MPC/Transportation- or								
14. LOGG SNF INTO MPC/Horisportation of	+			assume null backgrour	d dose	$oldsymbol{oldsymbol{oldsymbol{eta}}}$		
MPC/Storage-overpack or Emplacement	20	0		Remote	0	0	0.0	0.0
a. Instali a Spacer	10	- ŏ		Remote	0	0	0.0	8
b. Get Bare SNF Grapple				Remote	0	0	0.0	0.0
c. Get and inspect One Bare SNF assembly	10	0			0	ŏ	0.0	0.0
d. Emplace Bare SNF assembly if necessary	10	0		Remote	0	히	0.0	- 65
e. Put Bare SNF in Can	20	0		Remote			00	- 60
f. Install Can Ud	30	0	0	Remote	0	0		
Tolai	100	0			<u> </u>		0.0	0.0
lorgi								
in a second seco	1				11.			
15. Prep MPC/Storage-overpack from SNF	1			assume crane enclosu	ue poc	kgrou	nd dise	
fransfer cell to slorage	25	0	0	Remote	0	O	0.0	0.0
a. From Cell, Install MPC Inner Shield Plug&lid	10	0		Remote	0	O	0.0	0.0
b. Replace Port Plug	10	0		Remote	0	0	0.0	0.0
c. Unmate Storage Cask from Port				Operator	0	0	0.0	0.0
d. Open Transfer Station Door	5				10	8.7	44	0.1
e. Move Cask into Storage Cask Prep Room	30	30		Operator	2	50	59.0	0.3
1. HP Survey	60	30		Radiation Protection		220	146.7	02
g. Remove Lid Handling Device	25	20		Operators	2			- 60
g. Restleve Bottonary outside		10		Ragman	10	8.7	1.5	
	1	10	T i	Crane Operator	20	0.5	0.1	0.0
Consideration of the Considera		0	1	Operator	0	0	۵٥	0.0
g1. Close Transfer Station Door, simultaneously with g.	45	45	· ·	Welder	2:	220	165.0	0.2
h. Setup Remote Welding Equipment	1500			Remote	0	O	0.0	0.0
i. Weld MPC Inner Lid				QA Welder	2	220	110.0	0.1
1 Verity Weld	60		_		2	220	73.3	0.1
k. Remove Remote Welding Equipment	20			Welder	2	220		00
L Connect Evacuation/Inerting Equipment	10			Operator				0.0
m. Evacuate and Inert MPC	45	10		Operator	2	37	62	
114 - 1400000 - 1111 - 1		45		Operator	10	8.7	6.5	0.2
		5	5	1 Operator	2	220		0.0
- Disconnect Execution/Inerting Equipment	5	1 . ·		1 Welder	2	220		0.4
n. Disconnect Evacuation/Inerting Equipment	90			111000			110.0	0.1
o. Place and Seal Weld Valve Cover		90		1 Operator	2	220		
n. Disconnect Evacuation/Inerting Equipment o. Place and Seal Weld Valve Cover p. Place MPC Outer Lid	90	30		1 Operator		220 8.7	4.4	٥.
o. Place and Seal Weld Valve Cover	90	90 30 30		1 Operator 1 Rogman	2		4.4	0. 0.
o, Place and Seal Weld Valve Cover p. Place MPC Outer Lid	30	90 30 30		1 Operator 1 Rogman 1 Crane Operator	10 20	8.7	4.4 0.3	
o. Place and Seal Weld Valve Cover p. Place MPC Outer Lid g. Setup Remote Welding Equipment	30	90 30 30 30 45		Operator Rogman Crane Operator Welder	2 10 20 2	8.7 0.5	4.4 0.3 72.8	0.
o. Place and Seal Weld Valve Cover p. Place MPC Outer Lid q. Setup Remote Welding Equipment r. Weld MPC Outer Lid	90 30 45 600	30 30 30 46		1 Operator 1 Rogman 1 Crane Operator 1 Welder 0 Remote	20 20 20 0	8.7 0.5 97 0	4.4 0.3 72.8 0.0	0. 0. 0.
Place and Seal Weld Valve Cover P. Place MPC Outer Lid Q. Setup Remote Welding Equipment T. Weld MPC Outer Lid S. Verify MPC Outer Lid Weld	90 30 45 600	90 30 30 30 45 0 (30)) 5)	1 Operator 1 Rogman 1 Crane Operator 1 Welder 0 Remote 1 QA Welder	2 10 20 2 0	8.7 0.5 97 0 97	4.4 0.3 72.8 0.0 48.5	0. 0. 0.
Place and Seal Weld Valve Cover P. Place MPC Outer Lid Q. Setup Remote Welding Equipment T. Weld MPC Outer Lid S. Verify MPC Outer Lid Weld	90 30 45 600 20	30 30 30 45 45 0) (0) 30 20 20)))))	1 Operator 1 Rogman 1 Crane Operator 1 Welder 0 Remote 1 GA Welder 1 Welder .	2 10 20 2 0 2	8.7 0.5 97 0 97 97	4.4 0.3 72.8 0.0 48.5 32.3	0. 0. 0. 0.
O. Place and Seal Weld Valve Cover D. Place MPC Outer Lid q. Setup Remote Welding Equipment r. Weld MPC Outer Lid s. Verify MPC Outer Lid Weld t. Remove Remote Welding Equipment	90 30 45 600	90 30 30 30 46 0 0 0 30 0 20 0 12)))))	1 Operator 1 Rogman 1 Crane Operator 1 Welder 0 Remote 1 DA Welder 1 Welder 1 Operator	2 10 20 2 0 2 2 2	8.7 0.5 97 0 97 97	4.4 0.3 72.8 0.0 48.5 32.3 194.0	0. 0. 0. 0.
Place and Seal Weld Valve Cover P. Place MPC Outer Lid Q. Setup Remote Welding Equipment T. Weld MPC Outer Lid S. Verify MPC Outer Lid Weld	90 30 45 600 20	30 30 30 45 45 0) (0) 30 20 20))))))	1 Operator 1 Rogman 1 Crane Operator 1 Welder 0 Remote 1 QA Welder 1 Welder 1 Operator	2 10 20 2 0 2 2 2 2	8.7 0.5 97 0 97 97 97 97	4.4 0.3 72.8 0.0 48.5 32.3 194.0 2.9	0. 0. 0. 0. 0.
O. Place and Seal Weld Valve Cover D. Place MPC Outer Lid q. Setup Remote Welding Equipment r. Weld MPC Outer Lid s. Verify MPC Outer Lid Weld t. Remove Remote Welding Equipment	90 30 45 600 20	90 30 30 30 46 0 0 0 30 0 20 0 12))))))	1 Operator 1 Rogman 1 Crane Operator 1 Welder 0 Remote 1 QA Welder 1 Welder 1 Operator 1 Rogman 1 Crane Operator	2 10 20 2 2 0 2 2 2 2 10 20	8.7 0.5 97 0 97 97 97 97 8.7 0.5	4A 03 728 0.0 48.5 32.3 194.0 2.9	0. 0. 0. 0. 0. 0.
Place and Seal Weld Valve Cover P. Place MPC Outer Lid q. Setup Remote Welding Equipment r. Weld MPC Outer Lid s. Verify MPC Outer Lid Weld t. Remove Remote Welding Equipment u. Install Storage Cask Lid	45 600 20 180	90 30 30 30 30 45 45 0 30 30 20 120 22 22		1 Operator 1 Rogman 1 Crane Operator 1 Welder 0 Remote 1 QA Welder 1 Welder 1 Operator	20 20 20 20 20 20 20 20 20 20 20 20 20 2	8.7 0.5 97 0 97 97 97 97 8.7 0.5 59	4.4 0.3 72.8 0.0 48.5 32.3 194.0 2.9 0.2 59.0	0. 0. 0. 0. 0. 0.
O. Place and Seal Weld Valve Cover D. Place MPC Outer Lid q. Setup Remote Welding Equipment r. Weld MPC Outer Lid s. Verify MPC Outer Lid Weld t. Remove Remote Welding Equipment u. Install Storage Cask Lid V. HP Survey Cask	45 600 20 180	90 30 30 30 30 30 45 45 0 30 20 20 20 20 30 30 30 30 30 30 30 30 30 30 30 30 30		1 Operator 1 Rogman 1 Crane Operator 1 Welder 0 Remote 1 QA Welder 1 Welder 1 Operator 1 Rogman 1 Crane Operator 2 Radiation Protection	2 10 20 2 2 0 2 2 2 2 10 20	8.7 0.5 97 0 97 97 97 97 8.7 0.5 59	4.4 0.3 72.8 0.0 48.5 32.3 194.0 2.9 0.2 59.0	0. 0. 0. 0. 0. 0.
Place and Seal Weld Valve Cover P. Place MPC Outer Lid q. Setup Remote Welding Equipment r. Weld MPC Outer Lid s. Verify MPC Outer Lid Weld t. Remove Remote Welding Equipment u. Install Storage Cask Lid	45 600 20 180	90 30 30 30 30 30 46 46 30 20 20 20 20 30 30 30 30 30 30 30 30 30 30 30 30 30) 5 5 0 0 0 0 0	1 Operator 1 Rogman 1 Crane Operator 1 Welder 0 Remote 1 QA Welder 1 Welder 1 Operator 1 Rogman 1 Crane Operator	20 20 20 20 20 20 20 20 20 20 20 20 20 2	8.7 0.5 97 00 97 97 97 97 0.5 59	4.4 0.3 72.8 0.0 48.5 32.3 194.0 2.9 0.2 59.0	0. 0. 0. 0. 0. 0. 0.

		·····						
y. Close Storage Cask Prep Room Door	10			Operator Operators	2	0 59	19.7	_ <u>0</u>
z. Unsecure Cask from Carrier aa. Engage Storage Cask with Transporter	60		_	Operators	2	59	59.0	_ <u>u</u>
dd. Engage storage cask with transporter	 	30		Transporter Operator	15	0.5	03	ö
bb. Secure Cask to Transporter	20	20		Operators	2	59	39.3	Ö
cc. Move Cask to Storage Yard	60	30	2	Operators	10	8.7	8.7	C
ossume null background dose while moving)	1	60	1	Transporter Operator	15	0.5	0.5	7
	1	30		Radiation Protection	10	8.7	4.4	-
dd. Unsecure Cask from Transporter	20	10		Operators	2	59	19.7	_
assume ISFSI background dose)		20		Transporter Operator	15	0.5	0.2	
		10		Radiation Protection	10	8.7	1.5	_(
ee. Place Storage Cask on Pad	60	30		Operators	2	59	59.0	_2
		80		Transporter Operator	15	0.5	0.5	_2
	<u> </u>	30		Radiation Protection	10	8.7	4.4	1
ff. Return Unloaded Transport to Transfer Facility	50	25		Operators	10 15	0	0.0	- 0
(assume nul background dose)	 	25 25		Transporter Operator Radiation Protection	10		60	_
±-4-4	3.255			ROGGIOTI PIOTECTOTI	- "		1,703	
Total		1,200					1,144	
16. Prep MPC/Transportation-overpack from	 							_
SNF transfer Cell for Shipping		_		assume crane enclosu	re ba	ckgrou	nd dose	
a. From Cell, Install MPC Shield Plug	25	0		Remote	0	0	0.0	0
b. Replace Port Plug	10			Remote	0	0	0.0	0
c. Unmate Transportation-overpack from Port	10	0		Remote	0	0	0.0	0
d. Open Transfer Station Door	5	0		Operator	0	0	0.0	0
e. Move Cask into Storage Cask Prep Room	30	30		Operator	10	8.7 59	59.0	0
f: HP Survey	60	30		Radiation Protection	2	220	146.7	_
g. Remove Lid Handling Device	25	20 10		Operators	10	8.7	146./	0
		10		Ragman Crane Operator	20	0.5	0.1	_
Charles Carling Dags sign demonstrate	ļ	0		Operator	20	000	0.1	0
g1. Close Transfer Station Door, simultaneously h. Setup Remote Welding Equipment	45	45		Welder	2	220	165.0	ŏ
i, Weld MPC Inner Lid	1,500			Remote	ō	0	0.0	ō
i. Verity Weld	60	30		QA Welder	2	220	1100	0
k. Remove Remote Welding Equipment	20	20		Welder	2	220	73.3	Ō.
L Connect Evocurition/Inerting Equipment	10	10	1	Operator	2	220	36.7	0.
m. Evacuate and Inert MPC	45	10	1	Operator	2	37	62	O.
		45		Operator	10	8.7	6.5	0
n. Disconnect Evacuation/Inerting Equipment	5	5		Operator	2	220	18.3	0.
o. Place and Seal Weld Valve Cover	90	90	_	Welder	2	220	330.0	0
p. Place MPC Outer Lid	30	30		Operator	10	220 8.7	44	0.
		88		Ragman Crane Operator	20	0.5	0.3	<u> </u>
- Cata - Daniela Maldha Coulomad	45	25		Welder	2	97	72.8	<u> </u>
q. Setup Remote Welding Equipment r. Weld MPC Outer Ltd	600	- 3		Remote	0	Ö	0.0	ō
s. Verify MPC Outsy Lid Weld	60	30		QA Welder	2	97	48.5	0
1. Remove Remote Welding Equipment	20	20		Welder	2	97	32.3	0
u. Install Transportation Cask Lid	30	30	1	Operator	2	97	48.5	0
		20		Flagman	10	8.7	2.9	0
		20		Crane Operator	20	0.5	02	0
v. HP Survey Cask	60			Radiation Protection	2	59	59.0	Q.
w. Open Transportation Cask Prep Room Door	5			Operator	.0	0	0.0	0
x. Move Cask to Transportation Cask Staging Area	30			Operator	10	8.7 0.5	03	0.
And the Annual Property of the	 	30		Transporter Operator	15	0.0	0.0	0
y. Close Transportation Cask Prep Room Door	10	10		Operators	2	59	19.7	0
Unsecure Cask from Carrier 21. Engage Crane with Yoke to Transport Cask, simultaneously.		10		Operator	2	17	28	_
Z1. Engage Crare with Your to Harapart Case, STUBBARE	~~	10		Ragman	10		1.5	0
	 	10		Crane Operator	20	0.5	0.1	0
aa. Move Transport Cask to Washdown	10			Operators	10	8.7	2.9	0
		30		Crane Operator	20	0.5	0.1	0
bb. Install Platform	10			Operator	6	8.7	1.5	0
cc. Decontaminate Cask (if needed)	180			Operator	6		1.5	0
dd. HP Survey	40			Radiation Protection	2		28.7	0
	5			Operator	6		07	0
ee. Remove Platform			. 1	Operator	0		2.9	0
ee. Remove Platform ee1. Open MPC Transportation Cask Prep Room Door, simult	aneous	0					4.71	_
ee. Remove Platform		10	2	Operator Crane Operator	20			
ee. Remove Platform ee 1. Open MPC Transportation Cask Prep Room Door, simult ff. Move Transport to Receiving and Shipping	aneious 10	10 10	2	Crane Operator	20	0.5	0.1	
ee. Remove Platform ee 1. Open MPC Transportation Cask Prep Room Door, simult ff. Move Transport to Receiving and Shipping ff1. Close MPC Transportation Cask Prep Room Door, simultar	10 neous	10 10 0	2 1	Crane Operator Operator	20 0	0.5 0	0.1 0.0	0
ee. Remove Platform ee 1. Open MPC Transportation Cask Prep Room Door, simult ff. Move Transport to Receiving and Shipping	aneious 10	10 10 0 35	2 1 1 2	Crane Operator Operator Operators	20 0 10	0.5 0 1.8	0.1	0
ee. Remove Platform ee1. Open MPC Transportation Cask Prep Room Door, simult ff. Move Transport to Receiving and Shipping ff1. Case MPC Transportation Cask Prep Room Door, simultar gg. Lift Cask onto Rail Car	10 neous	10 10 0 35 35	2 1 1 2	Crane Operator Operator	20 0	0.5 0 1.8 0.5	0.1 0.0 2.1	0
ee. Remove Platform ee 1. Open MPC Transportation Cask Prep Room Door, simult ff. Move Transport to Receiving and Shipping ff1, Close MPC Transportation Cask Prep Room Door, simultar	10 neous 35	10 10 0 35 35	2 1 1 2 1	Crane Operator Operator Operators Crane Operator	20 0 10 20	0.5 0 1.8 0.5 17	0.1 0.0 2.1 0.3	0000

Table A1-8. MRS-MPC (continued)

E. Install Trunnion Blocks	20	20		Operators	2	32	21.3	02
E. Install transport Blocks		20	1	Crane Operator	20	0.5	0.2	0.
, Perform Shipping HP Survey Casids: periphery)	70	70	2	Operators	10	8.7	20.3	4.
, Perform Shipping hir Survey Councy, portationy		70	1	Prime Mover Operator	15	0.5	0.6	2
		70	- 1	Crane Operator	20	0.5	0.6	2.
		70	- 1	Radiation Protection	2	43	50.2	2.
kk Decontaminate Cask	60	10	2	Operators	2	43	14.3	0.
		10	1	Prime Mover Operator	15	0.5	0.1	0.
(f needed)		10		Crane Operator	20	0.5	0.1	0.
		10		Radiation Protection	10	8.7	1.5	0.
	70	70	2	Operators	21	43	100.3	4
I. Install Cask Restraints		70	ī	Prime Mover Operator	15	0.5	0.6	2.
		70	1	Crane Operator	20	0.5	0.6	2
		70	1	Radiation Protection	10	8.7	10.2	2
	110	110	2	Operators	2	43	157.7	7.
mm, Instoff Impact Limiters		110	1	Prime Mover Operator	15	0.5	0.9	3.
		110	1	Crane Operator	20	0.5	0.9	3
		110	ī	Radiation Protection	10	8.7	16.0	3.
	35	35	2	Operators	2	43	50.2	2
nn, Install Personnel Barrier		35	1	Prime Mover Operator	15	0.5	0.3	1.
		35	1	Crane Operator	20	0.5	0.3	1
		35	1	Radiation Protection	10	8.7	5,1	1
- distribution Park Door simultaneous		0	1	Operator	0	0	0.0	0
nn 1. Open Receiving and Shipping Bay Door, simultaneous	10	10	1	Prime Mover Operator	15	0.5	0.1	0
nn2. Hitch Site Prime Mover	20	0	1	Operator	0	0	0.0	0
nn3. Prepare Shipping Papers	10	10	2	Operators	10	8.7	2.9	0
oo. Move Cask to Protected Area Gate	(60	10	1	Prime Mover Operator	15	0.5	0.3	9
(assume rail siding background dose same as crane enclosu	Ĭ	10		Crane Operator	20	0.5	0.1	0
(assume null background while moving)		10	1	Radiation Protection	10	8.7	1.5	0
	5	5	2	Security Officers	2	17	2.8	9
pp. Perform Security check	5		2	Operators	10	8.7	1.5	0
pp1. Unhitch On-Site Prime Mover	 	5	1	Prime Mover Operator	15	0.5		6
the section (continue 3 cost)	60			operator-rail	15	1.2		0
qq. Make-up with other cask cars per train (assume 3 cars)	5			Operators	10	8.7	1.5	<u> </u>
rr. Hitch Off-Site Prime Mover	 	5		Prime Mover Operator	15	0.5		9
		2.275		T	1		1.873	

Table A1-9 through A1-12. Mined Geologic Disposal System (MGDS)

Due to lack of design detail at the MGDS, projected personnel exposures are interpolated from the MRS data. The majority of the difference in exposures is related to the different modal mix of rail and trucks expected at the MRS versus the MGDS. In addition, at the MGDS specialized activities such as the handling of HLW will take place, and the impacts are roughly estimated.

Table A1-9. MGDS-Reference

On the United State of the LACING						Bookg	round	·
Total Doses per Cask Handling for SPSs at the MGDS						men		
Revised 20 May 94/HWG						area		
Unload Rail Cask (obtain from MRS-RD/SPS)						crane	0.25	r -
Unload Rail Cask (obligh libit) Michael Jaray						decor		
	Direct	Bkod	Sum			pool	3	Γ
Load Emplacement Cask	(Dersor					ISPSI	2	
Steps - (1.2)			1,236					
51903 - (1.2)						null	0	
	otal Task Time(Nin.)	Dose Itme(Mn.)	Personnel Required(Persons /Tosk)	Occupation	Worlding Distances(Feet)	Cask Dose Rafe(mrem/hr)	Dose Received(Percu-mem)	Facility dose background (person-mem)
Courts Honorities: Concretions	풀	Š	5	Š	ş	8	2	Ŭ Š
Cask Handling Operations								L
1. Receive and Prep Emply		i						
Storage, Emplocement or								
Transportation Cask for Loading				assume null backgrou	nd do	se, init	ally	
a. Inspect Bills of Lading. Other Shipping Papers	10	10	1	Operator	0	0	0.00	0.0
b. Pull Cask into Security Area	5	5	1	Prime Mover Operator	15	0	0.00	
c. Security Inspection	30	30	2	Security Officers	2	0	0.00	
d. Perform HP Survey of Cask Externals and Trailer	30	30	2	Radiation Protection	2	0	0.00	
e. Take Cask to Protected Area	10	10	1	Prime Mover Operator	15	0	0.00	
f. Unhitch Off-Site Prime Mover	5	5	1	Prime Mover Operator	15			
g. Hitch Site Prime Mover	5	5	1	Prime Mover Operator	15			
h. Take Cask to Receiving and Shipping Bay Door	10	10	1	Prime Mover Operator	15	0		
h1. Open Receiving and Shipping Bay Door,							0.00	
simutianeously with step h.				Operator	0			
i. Take Cask into Receiving and Shipping Bay	5	5		Prime Mover Operator				
		<u> </u>		Ragman	10			
i, Unhitch Site Prime Mover	5	5	1	Prime Mover Operato	15	0		
Close Receiving and Shipping Bay Door,		1	<u> </u>		<u> </u>		0.00	
simultaneously with j.		<u> </u>		Operator	0			
n. Remove Tiedowns	50			Operators	3			
o. Remove Trunnion Blocks	10	10		Operators	3			+
		1	 	Crane Operator	20	0	0.00	-
ol. Open SNF Cask Prep Room Door.	<u> </u>	1		0	0			-
simultaneously with o.		10		Operator	2			
p Attach Crane to Yoke	5	<u> </u>		Operator	10			_
	ļ	!		Ragman Crane Operator	20			_
					2		0.00	
g. Engage Yoke to Cask	5	3 5		Ragman	10			0.0
	 	 		Crane Operator	20			0.0
Move Cask into SNF Cask Prep Room	!	1	 			1		0.0
Move Cask and Shir Cask resp accent Washdown Area (assume crone enclosure background do:	30	30	2	Operators	10	0	0.00	0.2
MCHECOALL MONTHS COME ALMOND STRONG STRONG	30			Crane Operator	20	i 0		0.13
s. Install Platform	10			Operator	6	0		0.0
1. Washdown Cask	30			Operator	2	+		0.25
u. HP Survey	35	3€		Radiation Protection	2			0.29
v. Remove Platform	10			Operator	6			0.0
w. Move Cask to Carrier	10			Operators	10			0.0
	<u> </u>	I K		Crane Operator	20			0.0
x. Place Cask on Carrier	2			Operators	10	****		0.17
	 	20		Crane Operator	20			0.1
y. Secure Cask to Carrier	20			2 Operator	20			0.0
y. 500 00 000 000 000 000 000 000 000 000		<u>, </u>	4	1 Crane Operator	1 4			000
		1	•	i	1			
y1 Close SNF Cask Prep Room Door		!	 	11Operator	1	1 0) O.C
y1 Close SNF Cask Prep Room Door simultaneously with y		<u> </u>		1 Operator 1 Operator	C		0.00	
y1 Close SNF Cask Prep Room Door simultaneously with y z Install Shield Platform	30	3()	1 Operator	-	C	0.00	0.1
y1 Close SNF Cask Prep Room Door simultaneously with y z Install Shield Platform aa Loosen Cask Lid Bolts	30	3() :	1 Operator 2 Operators	2	C	0.00	0.00
y1 Close SNF Cask Prep Room Door simultaneously with y z Install Shield Platform	30	30 30 5 20)) ;	1 Operator	2	2 0	0.00	0.13

Table A1-9. MGDS-Reference (continued)

ee. Operators Clear Prep Room	5	5		Operators	0	0	0.00	
ff. Move Cask Under Cell Port	5	5		Remote	0	0	0.00	
gg. Mate Cask to Port	30	30	0	Remote	0	0	0.00	
hh. Open Port and Remove Cask Lid	30	30	0	Remote	0	0	0.00	-
iolal	655	695					0.00	<u> </u>
2. Prep Emplacement Cosk from SNF Transfer Cell for Emp	placement			assume crane enclosu	te pox	horon	nd dose	
a. From Cell, Install Shield Plug	25	0		Remote	0	0	0.00	
b. Replace Port Plug	10	0		Remote	0	0	0.00	
c. Unmate Emplacement Cask from Port	10	0		Remote	0	0	0.00	
d. Open Transfer Station Door	5	5		Operator	0	0	0.00	
e. Move Cask into Storage Cask Prep Room	30	30		Operator	10	11	5.50	
f. HP Survey	60	30		Radiation Protection	2	59	59.00	
g. Remove inner Lid Handling Device	25	20		Operators	2	220	146.67	
		10		Ragman	10	11	1,83	
	1	10		Crane Operator	20	0.5	0.08	
g1. Close Transfer Station Door, simultaneous		0		Operator	0	0	0.00	
h. Setup Remote Welding Equipment	45	45		Welder	2	220	165.00	
L Weld Storage Casis Outer Lid	600	C		Remote	0	0	000	
j. Verify Storage Casics Outer Lici Weld	60	30		QA Welder	2	97	48.50	
k. Remove Remote Welding Equipment	20	20		Welder	2	97	32.33	
L Connect Evacuation/Inerting Equipment	10	10		Operator	2	97	16.17	
m. Evacuate and Inert Cask	45			Operator	2	37	6.17	
THE EVOCATION OF A TION OF THE PROPERTY OF THE		45		Operator	10	8.5	6.38	
n. Disconnect Evacuation/Inerting Equipment	5	5		Operator	2	97	8.08	
o. Place and Seal Weld Valve Cover	30	90		Weider	2	97	145.50	
p. Place Emplacement Outer Ltd	30	30		Operator	2	97	48.50	
		30		Ragman	10	8.5	425	
		39		Crane Operator	20	0.5	0.25	
q. Setup Remote Welding Equipment	45	45	1	Welder	2	97	72.75	
r. Weld Emplacement Casis Outer Lid	600	0		Remote	0	0	0.00	
s. Verify Emplocement Casks Outer Lid Weld	60	30		QA Welder	2	97	48.50	
t. Remove Remote Welding Equipment	20	20		Welder	2	97	32.33	
u. HP Survey Cask	60	30	2	Radiation Protection	2	59	59.00	
v. Open Storage Cask Prep Room Door	5	0		Operator	0	0	0.00	
w. Move Emplacement Cask Underground	30			Operator	10	8.5	425	
W. 10074 ST PROOF INT. CO.		30		Transporter Operator	15	0.5		0.1
x. Close Storage Cask Prep Room Door	5			Operator	0	0	0.00	_
y. Unsecure Cask from Carrier	10			Operators	2	59	19.67	
z. Engage Storage Cask with Transporter	ණ	30		Operators	2	59	59.00	
a Difference of the second of	60	30		Transporter Operator	15	0.5		0.1
aa. Secure Cask to Transporter	20	20	2	Operators	2	88	39.33	
Total	2045	725					1,030	<u> </u>

Table A1-10. MGDS-TSC

Total Doses per Cask Handling for TSC at the MG	os		1	Rgs mean/hr	Τ	Bocks	pround	
Revised 3 June 1994.HWG		Bkgd	Sum	Lid doses	_	mem		
Unload TSC		n-mem		inner	97	OE3O		
Steps - (1)	894	5.10	899	outer	60	crane	0.25	
				Tp/Tx cask lid	٤٥	deco	1	
Load Emplacement is described in the MGDS-R	D/SPS st	readsh	eet	Lateral Skin	59	pool	3	
						IS ^C SI	2	
						nuti	0	
								(Hell)
	fotal Task Time(Min.)	Dose time(Min.)	Personnel Required (Persons /Task)	Occupation	Working Distances(Feet)	Cask Dose Rate(memyhr)	Dose Received(Person-mem)	Focially dose background (person-rivern)
Cask Handling Operations	٥	å	<u>ة</u>	ဝိ	≱	8	<u> </u>	Š
		ļ			ļ	L		
Receive and Prep Loaded TSC	1					L		
for Unloading	<u> </u>			assume nuil backgrou				
a. Inspect Bills of Lading, Other Shipping Papers		0		Operator	0			0.00
b. Pull Cask into Security Area	5			Prime Mover Operato			0.04	0.00
c. Security Inspection	30	20		Security Officers	2		11.33	_
d. Perform HP Survey of Cask Externals and Trail	30	10		Radiation Protection	2		14.33	0.00
e. Take Cask to Protected Area	10	10		Prime Mover Operato	_		0.08	0.00
t. Unhitch Ott-Site Prime Mover	10	10		Prime Mover Operator		0.5	0.08	0.00
g. Hitch Site Prime Mover	10	10	1	Prime Mover Operato	15	0.5	0.08	0.00
h. Take Cask to Receiving and Shipping Bay Do	10	10	1	Prime Mover Operator	15	0.5	0.06	0.00
h1. Open Receiving and Shipping Bay Door,							0.00	0.00
simultaneously with step h.		0	1	Operator	0	0	0.00	0.00
i. Take Cask into Receiving and Shipping Bay	5	5	1	Prime Mover Operato	15	0.5	0.04	0.00
	i	5	1	Ragman	10	8.7	0.73	0.00
i. Unhitich Site Prime Mover	10	10	1	Prime Mover Operato	15	0.5	0.08	0.00
11. Close Receiving and Shipping Bay Door,							0.00	
simultaneously with j.	Ţ	0	1	Operator	0	0	0.00	0.00
k, Remove Personnel Barrier	25	25	2	Operators	3	32	26.67	0.21
(assume crane enclosure background dose)	· ·	25	1	Crane Operator	20	0.5	0.21	0.10
I. HP Survey	25	10	2	Radiation Protection	2	43	14.33	20
m. Remove Impact Limites	60	60	2	Operators	3	32	64.00	0.50
		60	1	Crane Operator	20	0.5	0.50	0.25
n. Ramove Tiedowns	10	10	2	Operators	3	32	10.67	0.08
o, Remove Trunnion Blocks	10	10	2	Operators	3	32	10.67	0.08
		10	1	Crane Operator	20	0.5	0.08	0.04
o1. Open SNF Transport Cask Prep Room Do	or,						0.00	
simultaneously with a.		0		Operator	0		0.00	
p. Attach Crane to Yoke	5			Operator	2	0		0.02
		5		Ragman	10			80
		5		Crane Operator	20		0.00	
q. Engage Yoke to Cask	5			Operator	2		1.42	
		5	1	Ragman	10		0.73	
		5		Crane Operator	20	0.5	0.04	
r. Move Cask Into SNF Transport Cask Prep Roor	n						0.00	
Washdown Area	30			Operators	10		1.80	_
	30			Crane Operator	20		0.25	
s. Install Platform	10			Operator	6		1.45	_
t. Washdown Cask	30			Operator	2		14.17	
u. HP Survey	35			Radiation Protection	2		21.50	_
v. Remove Platform	10			Operator	6		1.45	
w. Move Transport Cask to Carrier	10			Operators	10		0.60	
	ļ	10		Crane Operator	20		0.08	
x. Piace Transport Cask on Carrier	20			Operators	10		5.80	_
		20		Crane Operator	20		0.17	
y. Secure Cask to Carrier	20			Operator	2		28.67	
				10 A		0.5	0.17	0.08
	20	20	<u>1</u>	Crane Operator	20	0.5		
y1. Close SNF Transport Cask Prep Room Doo		20		Operator	0		0.00	0.00

Table A1-10. MGDS-TSC (continued)

					7 7	0.3	4 96	A 12
z. Instali Shield Platform	30	30		Operator		8.7	4.35	
aa. Attach Gas Sampling/Venting Rig	10	10		Operator	2	- 60	10.00	0.04
bb. Sample Gas Cavity	10	5		Operator	3	53	4.42	0.02
cc. Vent Cask Cavity	10	5	<u> </u>	Operator	3	53	AA2	0.02
dd. Remove Sampling/Venting Rig	10	10		Operator	2	- 60	10.00	0.04
ee. Install Cask Lid Lifting Device	20	20	2	Operators	2	60	40.00	0.17
40. 100.00		10	1	Ragman	10	8.7	1.45	0.04
		10	1	Crane Operator	20	0.5	0.08	
ff. Loosen/Remove Outer Cask Ltd	90	45	2	Operators	2	97	145.50	0.38
II. LOCASIVACIONE CONTRA	1	20	1	Ragman	10	8.7	2.90	0.08
	1	20	ī	Crane Operator	20	0.5	0.17	0.08
gg. Loosen Inner TSC Ltd Bolts	00	80	2	Operators	2	97	258.67	0.67
hh. Install Ud Handling Device	25	25	2	Operators	2	97	80.83	0.21
Attach Interface Pature	30	30	2	Operators	2	97	97.00	0.25
	10	10	1	Operator	6	8.7	1,45	0.04
j. Remove Platform	1 5	0		Operators	0	ol	0.00	0.00
ldc Operators Clear Prep Room	1 5	0		Remote	0	0	0.00	0.00
Move Cask Under Cell Port	30	o		Remote	0	o	0.00	0.00
mm. Mate Cask to Port	30	- 0		Remote	0	0	0.00	
nn. Open Port and Remove Inner Cask Lld	890	#85		VALLEY OF	+		894	
Total	1 870	-623		L				

Table A1-11 MGDS-MPU

Total Doses per Cask Handling for MPU at the MGDS							round	
Revised 3 June 94/HWG	Direct	Diame	C		<u> </u>	men	dose	}
Transfer MPU into Emplacement	(persor					CTON		
Steps - (1.2.3.4)			1631			deco		-
340.7(1222	12.0	1000				DOOL		-
	1					ISFSI	2	
						nuti	0	<u> </u>
	An)		Personnel Required (Persons/Task)		es(Feet)	(mrem/hr)	em)	For Many Associated Parks of Many
Cask Handling Operations	Total Task Time(Min.)	Dose time(Min.)	Personnel Requi	Occupation	Working Distances(Feet)	Cask Dose Rate (mem/hr)	Dose(Person-mem)	Facility does be
Receive and Prep MPU/Transportation-								
overpack for MPU transfer				assume nuli backgrou				
a .Inspect Bills of Lading, Other Shipping Paper.	10			Operator	- 0	0		
b. Pull Cask into Security Area	5			Prime Mover Operato	15 2	0.5 17	0.04	
c. Security Inspection d. Perform HP Survey of Cask Edernals and Trailer	40	25 10		Security Officers Radiation Protection	$-\frac{2}{2}$	43	14.17	_
	10	10		Prime Mover Operato	15	0.5	0.08	
Unhitch Cif-Site Prime Mover Hitch Site Prime Mover	10	10		Prime Mover Operato	15	0.5	30.0	
g. Take Cask to Receiving and Shipping Bay Door	10			Prime Mover Operato	15	0.5	0.08	
gl. Open Receiving and Shipping Bay Door, simultaneous	l.	0		Operator	0	0	0.00	0.0
h. Take Cask into Receiving and Shipping Bay	5	5	1	Prime Mover Operato	15	0.5	0.04	
		5		Ragman	10	8.7	0.73	
I. Unhitch Site Prime Mover	10	10		Prime Mover Operato	15	0.5	0.08	
ii. Close Receiving and Shipping Bay Door, simultaneous		0		Operator	- 0	0	32.00	_
j. Remove Personnel Barrier	30	30 25		Operators Crane Operator	20	32 0.5	0.21	
(assume crane enclosure background dose)	45	20		Radiation Protection	2	43	28.67	
k. HP Survey L. Remove Impact Limiters	110			Operators	3	32	117.33	
Resilies aspects (21325)		110		Crane Operator	20	0.5	0.92	
m. Remove Tiedowns	45	45	2	Operators	2	32	48.00	
		45		Crane Operator	20	0.5	0.38	0.19
n. Remove Trunnion Blocks	10	10		Operators		32	10.67	0.0
		10		Crane Operators	20	0.5 0	0.00	
o. Attach Crane to Yoke	5	5 5		Operators Ragman	10	- 6	000	_
		5		Crane Operator	20	ŏ	0.00	
p. Engage Yoke to Cask	6			Operators	2	17	1.42	οa
		5		Ragman	10	8.7		
		5	1	Crane Operator	20	0.5	0.04	
q. Open Prep Room Door	5			Operator	0	0	0.00	
r. Move Cask into Cask Prep Room Washdown Area	10	10		Operators	10	1.8	0.60	
	10	10		Crane Operator Operator	<u>20</u>	8.7	0.08	
s. Install Platform 1. Close SNF Cask Prep Room Door, simultaneously	10	10		Operator	- 8	0	0.00	
	55	45		Operators	2	17	25.50	
v. HP Survey	8	_		Radiation Protection	2	43	17.92	
w. Remove Platform	10	_		Operator	6	8.7	1.45	0.0
x. Move Transport Cask to Carrier				Operators	10	1.8	0.60	
w inche indispers description	10	_						nΛ
		10	1	Crane Operator	20	0.5	0.08	-
y. Place Transport Cask on Carrier	10 20	10 20	2	Operators	10	8.7	5.80	0.1
y. Place Transport Cask on Carrier	20	10 20 20	1 2 1	Operators Crane Operator	10 20	8.7 0.5	5.80 0.17	0.1
y. Place Transport Cask on Carrier z. Secure Cask to Carrier		10 20	1 2 1 2	Operators Crane Operator Operators	10	8.7	5.80	0.1
y. Place Transport Cask on Carrier	20	10 20 20 20	1 2 1 2	Operators Crane Operator	10 20 2	8.7 0.5 17	5.80 0.17 11.33 2.83 1.45	0.1 0.0 0.1 0.0
y. Place Transport Cask on Carrier z. Secure Cask to Carrier	20	2 8 8 E	1 2 1 2 1	Operators Crane Operator Operators Operator	10 20 2 2 10 20	8.7 0.5 17 17	5.80 0.17 11.33 2.83 1.45 0.08	0.1 0.0 0.1 0.0 0.0
y. Place Transport Cask on Carrier z. Secure Cask to Carrier zt. Disengage Crane with Yoke from Cask, simultaneous ca. Open MPU Transfer Room Door	20	88899	1 2 1 2 1 1	Operators Crane Operator Operator Operator Rogman Crane Operator Operator	10 20 2 2 10 20 0	8.7 0.5 17 17 8.7 0.5 0	5.80 0.17 11.33 2.83 1.45 0.08 0.00	0.11 0.00 0.11 0.00 0.00 0.00
y. Place Transport Cask on Carrier z. Secure Cask to Carrier zi. Disengage Crane with Yoke from Cask, simultaneous ca. Open MPU Transfer Room Door bb. Move Cask Carrier into Transfer Room	20	20 20 20 20 20 20 45	1 2 1 2 1 1 1	Operators Crane Operator Operators Operator Regman Crane Operator Operator Operator	10 20 2 2 10 20 0	8.7 0.5 17 17 8.7 0.5 0	5.80 0.17 11.33 2.83 1.45 0.08 0.00 6.53	0.17 0.06 0.17 0.04 0.04 0.04 0.16
y. Place Transport Cask on Carrier z. Secure Cask to Carrier zl., Disengage Crane with Yoke from Cask, simultaneous aa. Open MPU Transfer Room Door bb. Move Cask Carrier Into Transfer Room bbl. CloseTransfer Room Door	20 20 5 45	00 00 00 00 00 00 00 00 00 00 00 00 00	1 2 1 2 1 1 1 1	Operators Crane Operator Operators Operator Ragman Crane Operator Operator Operator Operator	10 20 2 2 10 20 0 10	8.7 0.5 17 17 8.7 0.5 0 8.7 0	5.80 0.17 11.33 2.83 1.45 0.08 0.00 6.53 0.00	0.17 0.06 0.17 0.04 0.04 0.05 0.05 0.05
y. Place Transport Cask on Carrier z. Secure Cask to Carrier zi. Disengage Crane with Yoke from Cask, simultaneous ca. Open MPU Transfer Room Door bb. Move Cask Carrier into Transfer Room	20	2	1 2 2 1 1 1 1 1 1 1	Operators Crane Operator Operators Operator Regman Crane Operator Operator Operator	10 20 2 2 10 20 0	8.7 0.5 17 17 8.7 0.5 0	5.80 0.17 11.33 2.83 1.45 0.08 0.00 6.53 0.00	0.17 0.06 0.17 0.04 0.04 0.05 0.05 0.05

Table A1-11 MGDS-MPU (continued)

		10		مار	perator	6	8.7	1.45	0.0
eel. Install Platform Edension	30	10			perator	2	70	11.67	0.0
Remove Vent Rig	25	25	_	_	perators	2	70	58.33	0.2
Install Cask Lid Lifting Device		10			agman	10	8.7	1.45	
		10			rane Operator	20	0.5	0.08	
D-ALIE	160	40		_	perators	2	70	93.33	
Locsen/Remove Cask Lid	:= †	20			agman	10	8.7	2.90	
		20			rane Operator	20	0.5	0.17	۵۵
The American Constrol	10	10		20	perators	2	43		0.0
install Contamination Control Engage MPC Crane Lifting Attachment to MPU	40	25		20	perators	2	97	80.83	0.2
Engage MPC Crane Bling Altocartes is to the		20		118	agman	10	8.7	2.90	
		20		10	rane Operator	20	0.5	0.17	0.0
	93	1045		\top				636	5.6
al				\Box					
Receive and Prep Storage-overpack									
(Emplacement-overpack) for MPU Transfer				0	ssume crane area bo	ckon	ouna		00
. Open Cask Prep Room Door	- 5			10	perator	_ 0	의	0.00	0.0
b. Engage Crane and Yoke to Storage Cask	10			1 0	>perator	2	0	0.00	0.0
, Eligage Cidie dia Tomo i Tomo		10			lagman	10	0		00
		10		1 0	rane Operator	20	0	0.00	00
: Move Cask to Empty Cask Staging Area	20	20			Operators	10	0	0.00	
Move Cask to Elitory Cast		20		1 0	Crane Operator	20	0	0.00	
c1. Close Cask Prep Door, simultaneously with c.		20			Operator	0	9	0.00	_
	35				Radiation Protection	2	0	0.00	01
i. HP Survey Decontaminate Cask	60				Operators	2	0	0.00	
Move Storage Cark to Carrier	10				Operators	2	0	0.00	_
, NOVO SICIOSA OCI.		10		10	Crane Operator	20	0	000	_
g. Place Empty Storage Cask on Carrier	35				Operators	10	0		_
, PICCE ENDITY GOODS CO.		35		10	Crane Operator	8	0	0.00	-
h. Secure Empty Storage Cask on Carrier	20		_		Operators	2	0	0.00	_
h1. Disengage Citane and Yoke from Storage Cask, sinns	francci	20		10	Operator	2	0	0.00	_
III. Deargogo Cita	Τ	<u></u>			Ragman	10	0	980	_
	Ι	20	1		Crane Operator	20	0		
L Open Transfer Room Door					Operator	0	0	0.00	_
j. Move Empty Storage Cask to Transfer Room	48			2	Operators	20	0	0.00	_
k, Install Platform Edension	110	10		10	Operator	6		0.00	
k1. Close Transfer Room Door, simultaneously		10		_	Operator	0		000	
L Prep Empty Storage Cask for Opening	1 2X				Operators	1 2		000	_
m. Attach Lid Lifting Device	12			2	Operator	2		000	_
TIL AROCH GO CHE STOCK	1	2	<u> </u>		Rogmon	10		0.00	
	T	2	_		Crane Operator	20		000	
n. Remove Cask Utl	. 5				Operators	2		- 60	_
IL ROLLDTO COLLEGE	I	5			Ragman	10			_
	1	5			Crane Operator	20			_
o, Remove Ltd Lifting Device	2			_	Operators	2			
U. KBI IDVO DO CITI P	I	2			Ragman	10			-
	J	2	<u> </u>		Crane Operator	2			_
p. Install Contamination Control		0 2		_2	Operators	1-3	1 - 4	0.00	_
[otal	39	0 75	5			 	┼	0.00	-
	1	1	1_			┼	 -		╁╌
Transfer MPU from Transportation- overpack to Storage	-overtx	xck	4_		asssume crane enck				<u></u>
(Emplocement-dyerpock)			4-			<u> </u>	394	A 57	7 0
a. Engage Crane to MPU Lift Attachment	<u> </u>		5	_	Operators	1	_		5 0
	┷		0		Ragman	1 2			0
	1		<u> </u>		Crane Operator	_	2 97		
b. Verity Vertical Alignment of MPC to Transport Cask			0		Operator				5 6
c. Clear Operators to a Shielded Area	<u> </u>		9	0					5 0
c.). Close Transfer Room Doors			0		Remote				o c
d. Raise MPU from Transportation Cask			0		Remote				ol d
e Move MPLI Ovist Storage Cask			의		Remote			00	_
t. Verify Vertical Alignment of MPU to Storage Cask		10	0		Remote			0.0	_
a, Correct Vertical Alignment		20	의_		Remote	_			ă i
h Lower MPC into Storage Cask		30	의_		Remote			00	_
h) Open Transfer Room Doors			의_		Remote Radiation Protection	_	2 5		
		_	<u>5</u>			+,	6 8		ŏ i
i Padiation and Contamination Survey		***	20		Operators	_	0 B		8
i Padiation and Contamination Survey			15		Rogman	_			3
L. Radiation and Contamination Survey J. Remove MPC Lift Attachment from MPU		1	15	1	Crane Operator Operators	+-	2 39	_	5
i. Radiation and Contamination Survey j. Remove MPC Lift Attachment from MPU	士		-						
i. Radiation and Contamination Survey j. Remove MPC Lift Attachment from MPU		10	5			+-	_	7 1.4	151
i Padiation and Contamination Survey		10	10	1	1 Rogman		0 8.		
L Radiation and Contamination Survey j. Remove MPC Lift Attachment from MPU		10	10 10	1			_	5 0.0	15
i. Radiation and Contamination Survey j. Remove MPC Lift Attachment from MPU		10	10	1	1 Rogman		0 8.	5 0.0)8

Table A1-11 MGDS-MPU (continued)

Transfer Cell for Emplacement	I			assume crane enclosu				
a. Remove Conformination Control From Loaded Storage C	20	20		Operators	2	59		
b. Install inner Emplocement Lid	60	30	2	Operators	2	97		
		30	1	Ragman	10	8.7		
		30	1	Crane Operator	20	0.5		
c. Setup Remote Welding Equipment	45	45	1	Welder	2	97		
d. Weld MPU Inner Lid	1500	0	0	Remote	0	0		
e. Verify Weld	60	30	1	QA Welder	2	97		
f. Remove Remote Welding Equipment	20	20	1	Welder	2	97		0.0
g. Connect Evacuation/Inerting Equipment	10	10	1	Operator	2	97		0.0
h. Evacuate and Inert Emplacement	45	10	1	Operator	2	37		0.0
IL EVOCAGIO CITO AND IL ETIPO CONTROL		45	1	Operator	10	8.7		
i. Disconnect Evacuation/Inerting Equipment	5	5	1	Operator	2	97	8.06	00
i. Place and Seal Weld Valve Cover	90	90	1	Welder	2	97	145.50	
k, Place Emplacement Outer Ltd	30	301	1	Operator	2	97	48.50	0.1
K Pides Ellipides list in Color do		30	1	Ragman	10	8.7	4.35	0.1
		30	1	Crane Operator	20	0.5	0.25	0.1
L Setup Remote Welding Equipment	45	45		Welder	2	97	72.75	0.1
m. Weld Emplacement Outer Ltd	600	o	O	Remote	0	0	0.00	0.0
n. Verify Emplocament Outer Lid Weld	60	30	1	QA Weider	2	97	48.50	0.1
p. Remove Remote Welding Equipment	20	20	1	Welder	2	97	32.33	O.C
p. Remove Platform Extension	5	5	2	Operators	6	11	1.83	O£
pl. Open Emplocement Transfer Room Door, simultaneously		<u></u>		Operator	0	0	0.00	O.C
q. Move Loaded Storage Cask to Storage Cask Prep Room!	10	10		Operator	10	8.7	1.45	O.C
r. Close Emplacement Transfer Room Door	5	0		Operator	O	0	0.00	0.0
	-60	30		Radiation	2	59	59.00	02
s, HP Survey Cask 1. Unsecure Loaded Emplacement Cask from Corrier	20	10		Operators	2	59	19.67	0.0
I. Unsecure Loaded Emplocement Cast admication		- 5		Operators	2	39.4	6.57	0.0
tl. Engage Crane with Yoke		10		Ragman	10	8.7	48.50 4.35 0.25 72.75 0.00 48.50 32.33 1.83 0.00 1.45 0.00 59.00	O.C
		10		Crane Operator	20	0.5	0.08	0.0
	5	- 10		Operator	0	0	000	0.0
u. Open Emplocement Cask Prep Room Door	10	10		Operators	10	8.7	2.90	0.0
v. Move Loaded Emplacement Cask to Transporter Bay	- 10	10		Crane Operator	20	0.5		0.0
	10	10		Operators	2	39.4		0.0
w. Disengage Crane from Loaded Emplacement Cask	10	10		Raaman	10	8.7		0.0
		10		Crane Operator	20	0.5		
		- 6		Operator	0	<u> </u>		
wl. Close Emplacement Cask Prep Room, simultaneously				Operators	2	- 59		
x. Engage Loaded Emplacement Cask with Transporter	60	30			15	0.5		
xl. Secure Loaded Emplocement Cask to Transporter for M	040	30	!	Transporter Operator	13	- 02	851	
Total	2795	740					631	

Table A1-12 MGDS-MPC

	Doses per Casic Handling for MPC at the MGDS					_	men)	round	Н
ovi	red 3 June 94/HWG					_	OteC:		-
		Direc:				_		0.25	-
Ġ.	sier MPC into Emplacement	(perior					crane	023	├
_	Stept - (1,2.3.4)	1,616	15.00	1631		-	deco		-
				ļ		_	pool:	3	!
							ISFSI :	2	⊢
				L			 ;		<u> </u>
				<u> </u>			nuli :	0	-
		Total Task Time(Min.)	Dose Itrae(Mn.)	Personnel Required (Persons/Task)	Occupation	Worlding Distances(Feet)	Cask Dase Rate (memyth)	Dose(Person-mem)	
C	k Handling Operations	≝	<u> </u>		ļ	- >			-
<u>. </u>	Receive and Prep MPC/Transportation-		 -		assume null backgrou		760 Pri	ch/	⊢
•	werpack for MPC transfer			 		0		0.00	1
Į,	nspect Bills of Lading, Other Shipping Papers	10			Operator Prime Mover Operato	15	0.5	004	-
	Pull Cask into Security Area	5			Security Officers	2	17	14.17	_
Ξ,	Security inspection	40				2	43	14.33	_
١.	Perform HP Survey of Cask Externals and Trailer	40			Radiation Protection	15	0.5	0.06	_
),	Unhitch Off-Site Prime Mover	10			Prime Mover Operato		0.5	0.08	_
	Hitch Site Prime Mover	20			Prime Mover Operato	15	0.5	0.08	
١	Take Cask to Receiving and Shipping Bay Door	10			Prime Mover Operato	_	0.5	- 000	_
0	t. Open Receiving and Shipping Bay Door, simultaneous	<u>. </u>	<u> </u>		Operator	0		004	_
١.	Take Cask into Receiving and Shipping Bay	5			Prime Mover Operato	15	0.5		_
			5		Ragman	10	8.7	0.73	_
	Unhitich Site Prime Mover	10			Prime Mover Operato	15	0.5	900	_
	Close Receiving and Shipping Bay Door, simultaneous		C		Operator	0			_
	Remove Personnel Barrier	30			Operators	2		32.00	_
os	sume crane enclosure background dose)	L	25		Crane Operator	8		0.21	_
	HP Survey	#		_	Radiation Protection	2	43	28.67	
	Remove impact Limiters	130			Operators	3		117.33	_
			110		Crane Operator	20		0.92 48.00	•
n	Remove Tiedowns	4			Operators	20		0.38	
_			45		Crane Operator	2		10.67	-
١.	Remove Trunnion Blocks	10	_		Operators	20		0.08	-
		ļ	10		Crane Operators	2		680	_
٥.	Attach Crane to Yoke			_	Operators	10			_
		ļ	- 5		Ragman Crane Operator	20			
		ļ				2		1,42	-
).	Engage Yoke to Cask				Operators				+-
					Rogman Crane Operator	10		0.04	
_		 -			Operator	0			
ł.,	Open Prep Room Door	<u> </u>			Operators	10		0.60	
٠.	Move Cask Into Cask Prep Room Washdown Area	 	1 10		Crone Operator	20			
		10			Operator	6		1.45	-
<u>. </u>	Install Platform	 "	-		Operator	0			-
٠	Close SNF Cask Prep Room Door, simultaneously	5			Operators	2			
	Washdown Cask	- 8	_	(Radiation Protection	2			-
<u>/.</u>	HP Survey		0 10		Operator	6		-	-
₩.	Remove Platform		0 10		Operators	10			
<u>×</u> _	Move Transport Cask to Carrier	 "	1		Crane Operator	20			
_	Place Transport Cask on Carrier	2			Operators	10		5.80	
<u>!-</u>	FIGGS (ICE BUTH) CON OIL COMM	 	2		Crane Operator	20	0.5	0.17	_
_	Secure Cask to Carrier	2	_	_	Operators	2	17	11.33	
-	d . Disengage Crane with Yoke from Cask, simultaneous		11		Operator	2	17	2.83	
	G. Chart Morte Anna Anna (Col) Count of court and anna anna	 -	1		Rogman	10	8.7		_
		 	1 1		Crane Operator	20	0.5		_
	. Open MPC Transfer Room Door	1			1 Operator		0	0.00)
20	. Move Cask Carrier into MPC Transfer Room		5 4		1 Operator	10	8.7		
20	bbl. Close MPC Transfer Room Door	 			1 Operator		0		-
	Aftach Vent Rig	1			1 Operator		2 70		
	Sample Gas Cavity				1 Operator	Γ :	3 53	4.4	_
	JULI DE COLUMN				1 Operator	1	2 394	6.5	7

Table A1-12 MGDS-MPC (continued)

A Land College College		10	1	Operator	6	8.7	1.45	0.0
eet. Instali Platform Extension f. Remove Vent Rig	10	10		Operator	2	70	11.67	0.0
ag, Install Cask Lid Lifting Device	25	25		Operators	2		58.33	02
AL BEIGE COM BUILD DEVICE		10		Ragman	10	8.7	1.45	0.0
		10		Crane Operator	20	0.5	0.08	0.0
nh. Loosen/Remove Cask Lid	160	40	2	Operators	2	70	93.33	0.3
II. Cooking to the co		20	1	Ragman	10	8.7	2.90	OC
		20		Crane Operator	20	0.5	0.17	0.0
Install Contamination Control	10	10	2	Operators	2	43	14.33	OC
. Engage MPC Crane Lifting Attachment to MPC	40	25		Operators	2	97	80.83	02
. Digogo an o orang		20	1	Ragman	10	8.7	2.90	0.0
		20		Crane Operator	20	0.5	0.17	0.0
otal	931	1045					636	5.6
<u> </u>								
Receive and Prep Storage-overpack								
(Emplacement-overpack) for MPC Transfer				assume crane area b	ckg	round		
a. Open Cask Prep Room Door	5	5	1	Operator	0	0	0.00	0,1
b. Engage Crane and Yoke to Storage Cask	10	10	ī	Operator	2	0	0.00	OJ
D. Linguige Grand Line 19 and		10	1	Ragman	10	0	0.00	0,1
		10		Crane Operator	20	0	0.00	0.0
c. Move Cask to Empty Cask Staging Area	20	20		Operators	10	0	0.00	0.
C. STOTE CAR TO STORY COM OTHER PERSON		20		Crane Operator	20	0	0.00	_
c1. Close Cask Prep Door, simultaneously with c.		20		Operator	0	0	0.00	_
	35	36		Radiation Protection	2	o	0.00	
d. HP Survey	60	60		Operators	2	Ö	0.00	
e. Decontaminate Cask	10			Operators	2	0	0.00	_
f. Move Storage Cask to Carrier	- 10	10		Crane Operator	20	o	0.00	0.1
St F. at. Steeres Carles Contain	35	35		Operators	10	- 0	0.00	
g. Place Empty Storage Cask on Carrie:	- 30	35		Crane Operator	20	Ö	0.00	_
	20	20		Operators	2	Ö	0.00	0.
h. Secure Empty Storage Cask on Carrier					2	C	0.00	_
h1. Disengage Crane and Yoke from Storage Cask, simul	Checu	20		Operator	10	70	0.00	
		28		Ragman	_			_
		20		Crane Operator	_20	0	0.00	_
i. Open MPC Transfer Room Door	5			Operator	0	0	0.00	0.0
j. Move Empty Storage Cask to MPC Transfer Room	45	45		Operators	20	0	0.00	0.
k. Install Platform Edension	10			Operator	6	0	0.00	0.0
k1. Close MPC Transfer Room Door, simultaneously with k		10		Operator	0	0	0.00	0.0
I. Prep Empty Storage Cask for Opening	20	20		Operators	2	0	0.00	
m. Attach Lid Lifting Device	20			Operator	2	0	0.00	
		20		Rogman	10	0	0.00	
		20		Crane Operator	8	0	0.00	_
n, Remove Cask Lid	55	55		Operators	2	0	0.00	_
		55	1	Rogman	10	0	0.00	02
		55	1	Crane Operator	20	0	0.00	0.2
o. Remove Lid Lifting Device	20	20	2	Operators	2	0	0.00	0.
		20	1	Ragman	10	0	0.00	0.
		20	1	Crane Operator	8	0	0.00	0,1
p. Install Contamination Control	20	20	2	Operators	2	0	0.00	0.
Jordi	390						0.00	4.6
IGGI		1						
 Transfer MPC from Transportation- overpack to Storage 	overbo:	ck						
		1	· · · · · ·	asssume crane enclos	ure b	ackar	ound do	58
(Emplacement-overpack) a. Engage Crane to MPC Lift Attachment	10	5	2	Operators	2		6.57	
d. Engage Clais Io as C da Airection		10		Ragman	10	8.7	1.45	0.0
		10		Crane Operator	20	_	0.08	
h Walte Wading Afrancos of MDC to Tonnonad Cont	10			Operator	2		16.17	
b. Verify Vertical Alignment of MPC to Transport Cask	10	_			_	_	0.00	
c. Clear Operators to a Shielded Area	 ''	0		Remote	ŏ		0.00	
c1. Close Transfer Room Doots	30			Remote	0		0.00	
and the second design of the second s	5			Remote	0	$\overline{}$	0.00	
d. Raise MPC from Transportation Cask		, U		Remote	0			
e. Move MPC Over Storage Cask		_		promiser of			0.00	
e, Move MPC Over Storage Cask f. Verity Vertical Alignment of MPC to Storage Cask	10	4		Pernote	2	l U		
e. Move MPC Over Storage Cask f. Verity Vertical Alignment of MPC to Storage Cask g. Correct Vertical Alignment	10 20	0	0	Remote	0			n
e. Move MPC Over Storage Cask f. Verity Vertical Alignment of MPC to Storage Cask g. Correct Vertical Alignment h. Lower MPC Into Storage Cask	10	0	0	Remote	· O	0	0.00	
e. Move MPC Over Storage Cask f. Verify Vertical Alignment of MPC to Storage Cask g. Correct Vertical Alignment h. Lower MPC Into Storage Cask h1. Open Transfer Room Doors	10 20 30	0 0	0	Remote Remote	0	0	0.00	0.
e. Move MPC Over Storage Cask f. Verity Vertical Alignment of MPC to Storage Cask g. Correct Vertical Alignment h. Lower MPC into Storage Cask h1. Open Transfer Room Doors i. Radiation and Contamination Survey	10 20 30	0 0 0 45	0 0 0 2	Remote Remote Radiation Protection	0 0 2	0 0 59	0.00 0.00 88.50	0.
e. Move MPC Over Storage Cask f. Verity Vertical Alignment of MPC to Storage Cask g. Correct Vertical Alignment h. Lower MPC into Storage Cask h1. Open Transfer Room Doors	10 20 30	0 0 0 45 20	0 0 0 2 2	Remote Remote Radiation Protection Operators	0 0 2 10	0 0 59 8.7	0.00 0.00 88.50 5.80	0.
e. Move MPC Over Storage Cask f. Verity Vertical Alignment of MPC to Storage Cask g. Correct Vertical Alignment h. Lower MPC Into Storage Cask h1. Open Transfer Room Doors i. Radiation and Contamination Survey	10 20 30	0 0 0 45 20	0 0 0 2 2	Remote Remote Radiation Protection Operators Ragman	0 0 2 10	0 59 8.7 8.7	0.00 0.00 88.50 5.80 2.18	0.0
e. Move MPC Over Storage Cask f. Verity Vertical Alignment of MPC to Storage Cask g. Correct Vertical Alignment h. Lower MPC Into Storage Cask h1. Open Transfer Room Doors i. Radiation and Contamination Survey j. Remove MPC Lift Attachment from MPC	10 20 30 45 30	0 0 0 45 20 15	0 0 0 2 2 1	Remote Remote Radiation Protection Operators Ragman Crane Operator	0 2 10 10	0 59 8.7 8.7 0.5	0.00 0.00 88.50 5.80 2.18 0.13	0.0.0.0.0
e. Move MPC Over Storage Cask f. Verity Vertical Alignment of MPC to Storage Cask g. Correct Vertical Alignment h. Lower MPC Into Storage Cask h1. Open Transfer Room Doors i. Radiation and Contamination Survey j. Remove MPC Lift Attachment from MPC	10 20 30	0 0 0 45 20 15 15	0 0 0 2 2 1 1	Remote Remote Radiation Protection Operatos Rogman Crane Operator Operator	0 0 2 10 10 20	0 59 8.7 8.7 0.5 39.4	0.00 0.00 88.50 5.80 2.18 0.13 6.57	0.0.0.0.0.0
e. Move MPC Over Storage Cask f. Verity Vertical Alignment of MPC to Storage Cask g. Correct Vertical Alignment h. Lower MPC into Storage Cask h1. Open Transfer Room Doors i. Radiation and Contamination Survey	10 20 30 45 30	0 0 0 45 20 15 15 15	0 0 2 2 1 1 1 2	Remote Remote Radiation Protection Operators Ragman Crane Operator Operators Ragman	0 0 2 10 10 20 2 10	0 59 8.7 8.7 0.5 39.4 8.7	0.00 0.00 88.50 5.80 2.18 0.13 6.57	0. 0. 0. 0. 0.
e. Move MPC Over Storage Cask f. Verity Vertical Alignment of MPC to Storage Cask g. Correct Vertical Alignment h. Lower MPC Into Storage Cask h1. Open Transfer Room Doors i. Radiation and Contamination Survey j. Remove MPC Lift Attachment from MPC	10 20 30 45 30	0 0 0 45 20 15 15 15 10	0 0 2 2 1 1 1 2 2 1	Remote Remote Radiation Protection Operatos Rogman Crane Operator Operator	0 0 2 10 10 20	0 59 8.7 8.7 0.5 39.4 8.7	0.00 0.00 88.50 5.80 2.18 0.13 6.57 1.45 0.06	0. 0. 0. 0. 0. 0. 0.
e. Move MPC Over Storage Cask f. Verity Vertical Alignment of MPC to Storage Cask g. Correct Vertical Alignment h. Lower MPC Into Storage Cask h1. Open Transfer Room Doors i. Radiation and Contamination Survey j. Remove MPC Lift Attachment from MPC	10 20 30 45 30	0 0 0 45 20 15 15 15 10	0 0 2 2 1 1 1 2 2 1	Remote Remote Radiation Protection Operators Ragman Crane Operator Operators Ragman	0 0 2 10 10 20 2 10	0 59 8.7 8.7 0.5 39.4 8.7	0.00 0.00 88.50 5.80 2.18 0.13 6.57	0. 0. 0. 0. 0.

Table A1-12 MGDS-MPC (continued)

MPC transfer Cell for Emplocement		I		assume crane enclosu			SOD DOLL	<u> </u>
a. Remove Contamination Control From Loaded Storage C	20	20	2	Operators	2	59		
b. Install Inner Emplocement Lid	60	30	2	Operators	. 2	97	97.00	_
5. B M C		30	1	Ragman	10	8.7	4.35	0.13
		30	1	Crane Operator	20	0.5	0.25	0.13
c. Setup Remote Welding Equipment	45	45		Welder	_2	97	72.75	0.19
d. Weld MPC Inner Lid	1500	0		Remote	0	0		
e. Verity Weld	60	30	1	QA Welder	2	97	48.50	0.13
1. Remove Remote Welding Equipment	20	20	1	Welder	2	97	32.33	0.08
g. Connect Evacuation/Inerting Equipment	Cif	10	1	Operator	2	97	16.17	0.04
h. Evacuate and Inert Emplacement	45	10	1	Operator	2	37	6.17	0.04
11. gradesia di la constanti di		45	1	Operator	10	8.7	6.53	0.19
I. Disconnect Evacuation/Inerting Equipment	5	5	1	Operator	2	97	8.08	0.02
j. Place and Seal Weld Valve Cover	90	90	1	Welder	2	97	145.50	0.38
k. Place Emplacement Outer Ltd	30	30	7	Operator	2	97	48.50	0.13
R PROBEITEROUSING CONTRACT		30	ī	Rogman	10	8.7	4.35	0.13
		30	1	Crane Operator	20	0.5	0.25	0.13
L Setup Remote Walding Equipment	45	45	1	Welder	2	97	72.75	0.19
m, Weld Emplacement Outer Lid	600	0	0	Remote	0	0	0.00	0.00
n. Verify Emplacement Outer Ltd Weld	60	30	ī	QA Welder	2	97	43.50	0.13
o. Remove Remote Welding Equipment	20	20	1	Welder	2	97	32.33	0.06
p. Remove Platform Extension	5	5	2	Operators	6	- 11	1.83	0.04
pl. Open Emplacement Transfer Room Door, simultaneously		0	1	Operator	0	0	0.00	0.00
q: Move Loaded Storage Cask to Storage Cask Prep Roam	10	10	1	Operator	10	8.7	1,45	0.04
r. Close Emplacement Transfer Room Door	5	o	1	Operator	0	0	0.00	0.00
s. HP Survey Cask	6D	30		Radiation	2	59	59.00	0.25
Unsecure Loaded Emplocement Cask from Carrier	20	10	2	Operators	2	59	19.67	0.08
tl. Engage Crane with Yoke		5	2	Operators	2	39.A	6.57	0.04
IL BIDODE CIONE WITH TOKE		10	1	Roaman	10	8.7	1.45	0.04
		10	1	Crane Operator	20	0.5	0.08	0.04
u. Open Emplacement Cask Prep Room Door	5	0	1	Operator	0	0	0.00	0.00
v. Move Loaded Emplacement Cask to Transporter Bay	10	10		Operators	10	8.7	2.90	0.08
v. Move Locked Elipidostielli Conto lidispolisi boy		10		Crane Operator	20	0.5	0.08	0.04
w. Disengage Crane from Loaded Emplocement Casts:	10	10		Operators	2	39.4	13.13	0.06
w. Disengage Crane from Loaded Emplocement Case		10		Ragman	10	8.7	145	0.04
	+	10		Crane Operator	20	0.5	0.08	0.04
wt. Close Emplacement Cask Prep Room, simultaneously		0		Operator	0	٥	0.00	0.00
Tonge of the second of the sec	60	30		Operators	2	59	59.00	0.25
xt. Secure Loaded Emplacement Cask with transporter for Mr.		30		Transporter Operator	15	0.5	0.25	0.13
Total	2795	740	<u> </u>	I			851	3.71

A2. FACILITY ROUTINE RADIATION EXPOSURES INPUTS

This portion of the Appendix A forms a foundation for the facility routine exposure calculations that were shown in Appendix Section A1. The facility operation procedures and initial estimates of exposures are based on utility operations experience and data from EPRI reports. The operation exposures for the MPC system and the alternative systems are made consistent within each CRWMS facility, and are used to create the detailed exposures steps and tables for other CRWMS designs, including the reference scenario, TSC system, and MPU system. This process includes organizing and harmonizing of the input data to provide a consistent basis for all alternatives.

These data are used to estimate the routine radiological exposures in the CRWMS facilities. The data are based on dose rates measured during operations with comparable casks under conditions similar to those of the reference scenario and the MPC system. In this appendix the exposures with the more readily justified ALARA techniques, and the basic conventional operating practices exposures are shown. Results of the final tradeoffs of cost and occupational exposures will determine the actual occupational exposures during facilities operations. These estimates correspond to the exposures during the first 2 to 5 cask handlings at each facility. Learning experience will improve handling times and positioning to reduce exposures subsequently. The conservatism introduced by neglecting learning is about 10 to 30% of exposure reduction during 6,000 handlings at plausible learning rates, Reference 6 of this Appendix.

The estimated exposures are conservative since specific use of ALARA techniques was not yet included in the estimated times or the exposures. The calculations for this report, as shown in the first section of this appendix, are based on the nominal exposure values and do not use the ALARA data.

A2.1 APPLYING ALARA TECHNIQUES

The dose estimates were reviewed to identify high dose activities. The high dose activities are associated with radiation streaming from the cask during lid installation, whether the lid was welded or bolted. The dose for these operations can be reduced by using temporary lead shielding, such as lead blankets, tubular lead shields, and curved lead inserts for the annulus, to reduce the dose received by workers setting up or removing welding equipment and welding valve cover plates. The thicknesses of these shields vary depending on the worker dose rate permissible.

The ALARA techniques are based on an assumption that the welding equipment can be modified to do some of the activities now performed manually at most utilities. For example, cameras could be attached to welding equipment to inspect the weld so that manual close-range Quality Assurance (QA) inspection would not be needed near the lid of the cask. Also, welding equipment could be lowered with the cask lid so that operators would not have to guide the lid down onto the cask. The welding equipment could also be designed to provide automatic centering and alignment. Of course, this automatic processing may take longer than manual setup and removal of equipment. Detailed studies for time versus exposure need to be performed to determine the best way to set up and remove the welding equipment.

The welding equipment could also be used for other ALARA dose reduction procedures. A 1-part water fluorescing dye could be applied to the lid weld, with an attachment to the welding system. After the required dwell time a water rinse could be applied, with a close coupled vacuum system to remove water. Once the excess water is removed a close-up video camera could be used to examine the weld area for defects disclosed by the dye. Although such modifications can be made to existing welding systems to reduce workers' exposures, cost tradeoffs of worker exposure versus automation are needed to determine if the changes are reasonable.

Other ALARA procedures, such as the installation and use of remote controlled automated equipment, can reduce the radiation exposure to workers to near zero, since no workers are required nearby during high dose operations. Remote automated equipment is usually more expensive than temporary shielding or modifications of existing equipment. Examples of equipment are robotic arms with welding equipment that are programmed to weld cask lids of specific diameters. Robots could take "swipes" of incoming casks to quantify the amount of contamination on the cask, and robots could be designed and programmed to place and torque bolts on the transportation casks. Sandia National Laboratory is reviewing the use of remote automated equipment at the MRS facility to reduce occupational exposure. Sandia National Laboratory has visually and physically demonstrated several types of automated equipment that would reduce worker exposures. However, ALARA techniques have to be cost-justified to determine if the procedures are worth the expense.

In this dose assessment, an assumption was made based on utility experience and topical reports from cask vendors that the welding related dose can be reduced by a factor of 10 if suitable temporary shielding is used in the welding equipment setup and removal. Temporary shielding around the lid can obstruct the quality assurance activities for lid weld verification. For this report, no dose reduction was assumed for these activities. The results of the ALARA evaluation, which take credit for use of common, easily justified dose reduction techniques, are included in the tables of this appendix.

A2.2 BASIS OF ROUTINE EXPOSURE EVALUATION

A2.2.1 Fuel Characteristics and Heat Generation

In these dose assessments, actual dose rates from existing Independent Spent Fuel Storage Installations (ISFSIs) were used to determine the occupational exposures incurred from handling the MPCs and the reference scenario. Utilities with SNF storage facilities on-site provided fuel characteristic information as well as dose rate profiles for their particular fuel and casks. All of the fuel assemblies currently in storage at the existing ISFSIs, that we contacted, were 15 x 15 PWR fuel assemblies. The burnup of the fuel assemblies stored ranged from 21 gigawatt-days (GWD)/MTU to 36 GWD/MTU. The emichments for the fuel in the casks reviewed ranged from 1.86 % to 3.2 % U-235. The fuel enrichment and burnup are representative of the fuel that will be handled in the CRWMS.

A2.2.2 Dose Rate Profiles

Representative dose rate profiles based on several types of casks are used, depending on the cask handling operations taking place. Figures A2-1 through A2-7 are based on actual dose rate

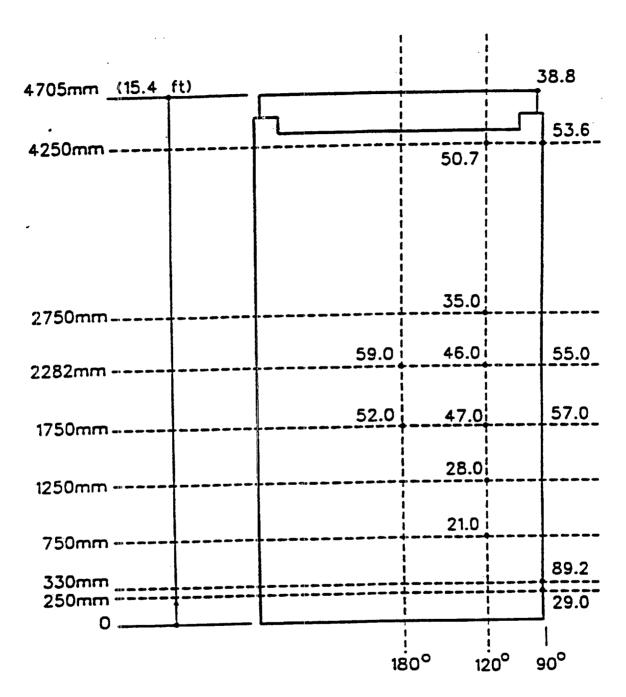
profiles for representative 24 element PWR storage cask and transportation casks. Figures A2-1 through A2-5 show conservative estimates based on the TN-24P and MC-10 casks used at Virginia Power's ISFSI; and, the Nuclear Horizontal Module Storage (NUHOMS)-24P ISFSI at Duke Power's Oconee Nuclear Station. Dose rate profiles are similar for these casks. The dose rate profile estimates were based on actual dose rate profiles documented in two Electric Power Research Institute (EPRI) reports, EPRI NP-5128 and EPRI NP-5268, (References 2 and 3, respectively). Figures A2-6 and A2-7 illustrate the GA-4 transportation cask dose rates on the truck. The data are from the GA-4 and GA-9 Final Design Reports, References 4 and 5.

The GA-4 transportation cask dose rate profile was used to represent dose rates due to relatively distant handling of loaded truck or rail casks, while the casks are on the truck or rail vehicles. Doses at over 6 feet depend on the reflection from the truck or rail vehicle beds. Doses in facilities or ISFSI areas, especially at working distances of over 6 feet, will include a background flux. With unloaded or empty casks, canisters, and overpacks the background is the only dose. For ALARA some protection of workers against the background dose probably will be provided. The GA-4 transportation casks can transport 4 PWR assemblies. The same transportation cask dose rate profile was used for both truck and rail. Although there was a GA-9 BWR transportation cask for transporting 9 BWR assemblies, the PWR transportation cask had a more conservative total dose rate profile than the BWR cask.

The radiation protection survey area dose rate, 43 mrem/hr, was an average taken at the surface on the transportation cask. Any vehicle operator, including a crane operator, is assumed to be in a shielded cab or at a distance so that the dose rate in the cab is 0.5 mrem/hr. This is based on the GA-4 transportation cask cab dose rate, Reference 4. Welding operations performed on primary lids, installed after installing the shield plug, are assumed to have a streaming dose rate equivalent to that of a cask with water in the annulus, as shown in Figure A2-5.

The transporter at the MRS facility is assumed to be a transporter/crane combination. The transporter operator could operate the crane used in moving MPCs to and from the storage pad. However, at the utilities, the transporter and crane are separate vehicles that are used in taking the MPC or transfer cask to and retrieving it from the at-reactor storage yard. Also, the general working area dose rate in the storage area is assumed to be roughly 2 for average loading, with a maximum of 11 mrem/hr. The average storage area dose rate depends on the average spacing between casks, orientation of the casks vertical or horizontal, number of casks in storage, and the storage area pad or cell loading/unloading sequence, and the traffic flow pattern used to minimize traffic movement near loaded storage casks.

A Prime Mover referred to any type of heavy haul equipment that was used to move transfer casks and transportation casks at utilities, the MRS or the MGDS facility. A Prime Mover may be a train engine for rail transportation casks or a tractor/trailer used to move the casks on-site or off-site.



DOSE RATE IN UNITS OF mr/hr DISTANCE IN mm

Figure A2-1. Distance Versus Dose Rate Profile For the Metal Cask With Neutron Shielding

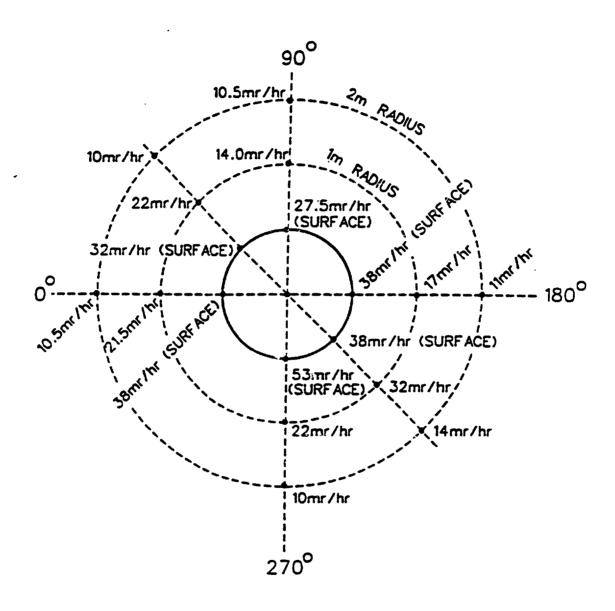


Figure A2-2. Distance Versus Dose Rate Profile For the Metal Cask With Neutron Shielding

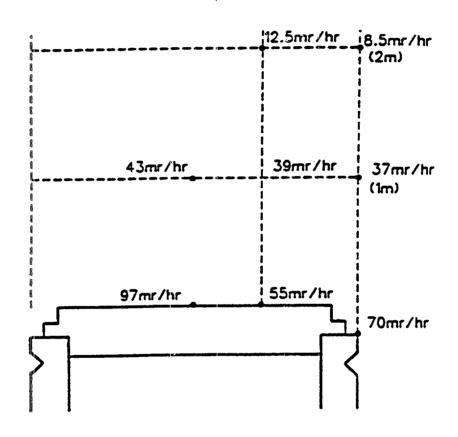


Figure A2-3. Metal Cask Top Dose Rate Profile With No Neutron Shielding

10mrem/hr @ 30cm (N)
20mrem/hr @30CM (Y)
1000mrem/hr @30CM (Y)
1000mrem/hr @30cm (N)
20mrem/hr @30CM (Y)
3000mrem/hr @30CM (Y)
3000mrem/hr @4/2" (Y)
400mrem/hr @30CM (Y)
600-800mrem/hr @4/2" (Y)

Figure A2-4. Working Condition Dose Rates for Welding of the Top Cover Plate Weld

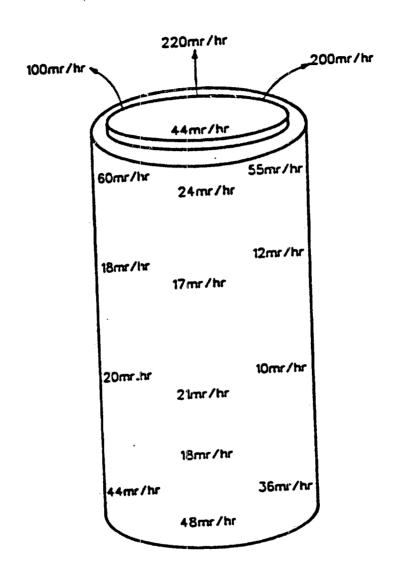


Figure A2-5. Working Area Dose Rates for the Shield Plug Welding (Gamma and Neutron Exposure with Water in the Cask and Annulus)

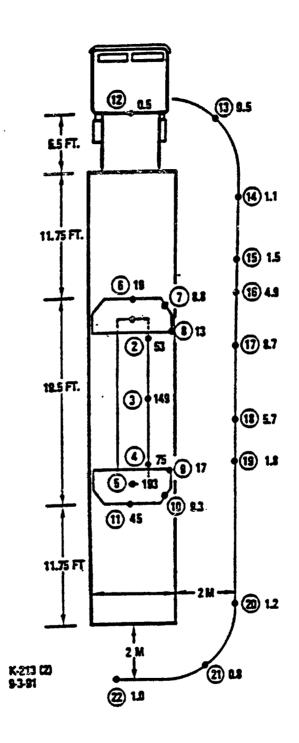
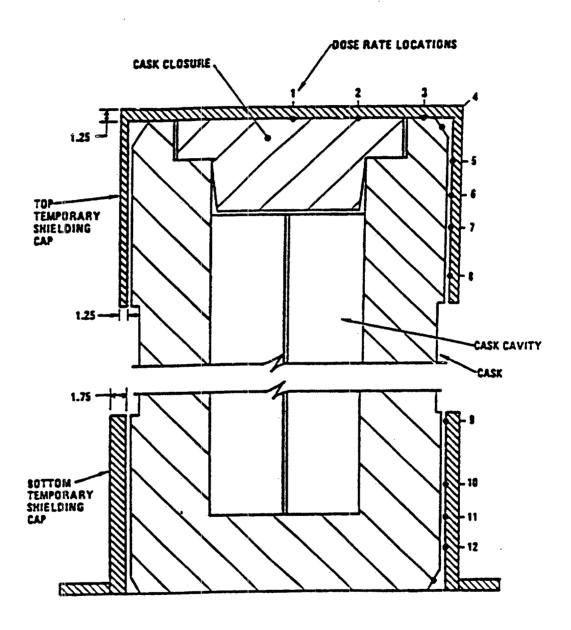


Figure A2-6. Total Dose Rate (mrem/hr) Near GA-4 Cask in Normal Condition. Ref. 5



Dose rate at numbered points; See Table A-11

Figure A2-7. GA-4 Cask Corner Surface Dose Rates Ref. 5 (Dimension in Inches) with Dose Point Rates. (see Table A2-1)

Table A2-1. GA-4 Cask Corner Surface Dose Rates (Reference 5)

Dose Point	Dose Rate Without Temporary Shielding (mrem/hr)	Dose Rate With Temporary Shielding (mrem/hr)
1	197.3	110.2
2	114.8	63.7
- 3	34.0	18.5
4	120.5	19.4
5	469.5	96.7
6	267.8	68.7
7	148.4	47.7
8	160.4	61.0
9	81.4	28.3
10	220.9	48.6
11	663.5	99.1
12	620.2	77.5

A2.3 RADWASTE FACILITY EXPOSURE

A2.3.1 Utilities

No dose assessment was performed on radwaste handling operations at utilities, with respect to loading casks for shipment to the MRS facility. The radwaste generated at the utility during the loading operations in the utility spent fuel pool is assumed to be negligible compared to the amount of radwaste that is normally generated at the utility for normal pool cleaning and dry active waste processing. The difference in radwaste produced during the loading of a transportation cask via the spent fuel pool and the loading of a MPC via the spent fuel pool is not significant because the same operations are used.

A2.3.2 MRS Facility

MRS facility radwaste in the reference scenario included high efficiency particulate air (HEPA) filters from the ventilation system, fluid filters from cask decontamination, and dry active low level waste. The volume of radwaste expected to be produced in the reference scenario was summarized in Table A2-2. The occupational exposure due to the handling of the reference scenario radwaste was larger than the MPC system radwaste occupational exposure value, because the volume of HEPA filters disposed of in the reference scenario was greater than in the MPC system. The reduction in bare SNF handling reduced the expected wastes from bare fuel handling operations.

Table A2-2. Reference Scenario Radwaste

Radwaste Type	Volume (ft³)	Activity (Curies Cobalt-60 equivalent)
Dry HEPA filters Transfer cell vacuum filter Wet cartridge filters Wet demineralization resins Dry active waste	720 1 6 90 200	90 477 9 5 10

Radwaste at the MPC system MRS facility also included high efficiency particulate air (HEPA) filters from the ventilation system, fluid filters resulting from cask decontamination, and dry active low level waste. The amount of Radwaste produced at the MPC system MRS facility as a result of handling MPCs was included in Table A2-3 below.

Table A2-3. MPC System Radwaste

Radwaste Type	Volume (ft³)	(Curies Co ⁶⁰ equivalent)
Dry HEPA filters	144	18
Transfer cell vacuum filter	1	52
Wet cartridge filters	6	9
Wet demineralization resins	9 0	5
Dry active waste	150	10

Workers in the Radwaste Facility portion of the MRS facility will incur some exposure due to changing out filters in various systems, handling dry active low level waste, mechanical maintenance, security, or any other type of occupational requirements in the Radwaste areas. Dose assessments of the Radwaste Facility were performed in five areas expected to contribute to occupational exposure, as described here.

1. Radioactive Contaminants accumulate in the HEPA filters due to the ventilation flow through these filters. Based on the current design of the MRS facility, we assume that 4 banks (2 banks of HEPA filter and 2 banks of refilters), totaling 12 filters, are changed per year. The dose rate is assumed to be about 5 rem/hr per filter bank, on contact. The labor requirements for the changeout of these filter banks are two persons for 1 hour in a 50 mrem/hr field, using extension tools and a shielding transfer container. Based on these assumptions, the exposure to personnel for filter changeout is,

(4 filter banks/year)(50 mrem/hr)(2 persons)(1 hr)(1 rem/1000 mrem)

= 0.4 person-rem/year, for transfer cell HEPA filter operations

All other HEPA filters operations in areas such as the cask preparation area, storage cask load-out, maintenance bay, and operation gallery are assumed to yield a personnel exposure equivalent to 0.4 person-rem/year.

2. Filters and demineralizers process the decontamination fluid; approximately 200 gallons per cask, produced during cask decontamination. Two filters per year are assumed to be changed out. The filter dose rate on contact was assumed to be 5 rem per hour. Handling operations are based on ALARA practices to reduce the working area dose rate to 50 mrem/hr. The dose to two persons changing out the fluid filter is as follows:

(2 filters/year)(2 persons)(1 hr)(50 mrem/hr-filter)(1 rem/1000 mrem)

= 0.2 person-rem/year, for fluid filter changeout

Personnel exposure from changing-out demineralizer resins and associated activities is estimated as 0.2 person-rem/year.

3. The collecting, sorting, compacting, drumming, storing, handling, and loading of dry active low level waste requires two persons working 5 days a week, 24 hours a day, year around.

The working area dose rate is 0.5 mrem/hr. Based on the assumptions, the total personnel exposure from handling dry active low level waste is as follows:

- (2 persons)(6,240 hr/year)(0.5 mrem/hr)(1 rem/1000 mrem)
- = 6.2 person-rem/yr, for low level waste handling
- 4. Exposure of personnel as a result of laundry processing activities is estimated to be approximately 5 person-rem/year.
- 5. Access to the Radwaste area is required for mechanical maintenance activities, inspections, security, and radiation protection requirements. The occupational exposure is from the access requirements and exposure rates in the area. Access exposure estimates are based on 10 persons per day for one hour in a 2.5 mrem/hr exposure rate area. The requirement results in personnel exposure as follows:
 - (10 persons/day)(1 hr)(365 days/year)(2.5 mrem/hr)(1 rem/1000 mrem)
 - = 9.1 person-rem/year, for radwaste area access

The assumptions for occupational exposure due to MPC system radwaste handling were conservative based on current operational information. The exposure is summarized as follows:

0.4 person-rem/year	Transfer Cell prefilter and HEPA filter changeout
0.4 person-rem/year	other HEPA filter operations
0.2 person-rem/year	fluid filter changeouts
0.2 person-rem/year	demineralizer operations
6.2 person-rem/year	low level waste
5.0 person-rem/year	handling laundry and contaminated clothing
9.1 person-rem/year	radwaste area access
21.5 person-rem/year	all radwaste facility activities, for MPC system

The reference system occupational exposure is estimated to be 26. person-rem/year. This value was included in the total estimated occupational exposure for the reference MRS system facility in the MRS Conceptual Design Report (MRS CDR), Reference 1. The assumptions for occupational exposure from reference scenario radwaste handling were conservative based on current operational information.

A2.4 UTILITIES SYSTEM DOSE ASSESSMENT

A2.4.1 Reference Scenario

The exposure associated with cask handling at the utilities in the reference scenario are normalized to the MPC system utility SNF transfer and storage operations. The major differences between the reference scenario and the MPC system are that more transportation casks are

handled in the reference scenario, and the casks have bolted rather than welded lids. The following scenarios are used for the utilities in the reference scenario. A description of the typical estimated dose from operations is included.

Truck ("25 ton") transportation cask loaded in-pool at reactor and placed on a truck for shipment to an MRS

The operations with this scenario are identical to Table A2-5, Steps 1 through 5 of the MPC utilities dose estimate. These operations expose personnel to 0.4 person-rem/cask handled. Application of ALARA techniques could reduce the exposure to 0.2 person-rem/cask.

Large ("100 ton") and moderate ("75 ton") sized rail transportation cask loaded in-pool at reactor and placed on a train for shipment to an MRS

These operations are similar to Table A2-5, Steps 1 through 5 with the exception of the times associated with the lid installation and decontamination tasks for the rail transportation cask. ALARA procedures can be applied in Step 4 of Table A2-5. The rail-times should be used in Table A2-5, as appropriate.

Large and moderate sized rail transportation casks loaded at utilities and placed on a train for shipment to a MRS (includes cask-to-cask transfer for an optimistic capability scenario)

This exposure steps per cask are identical to the steps in Table A2-4, Steps 1 through 6 and 10 through 11 for rail transportation casks used in the cask-to-cask transfer method, excepting the lid installation and decontamination with the rail transportation cask. An ALARA based exposure is 1.9, reduced from 2.4. ALARA techniques may be used in Step 4 of the Table A2-4.

Large and small non-transportable MESCs loaded in-pool at reactor and placed in concrete modules for on-site dry storage

These tasks for large and small non-transportable multiple element storage containers (MESCs) loaded in-pool at reactors and placed in concrete modules for on-site dry storage are similar to those of Table A2-3, Steps 1 through 5 and Steps 11-13 of the MPC utilities. The total exposure during loading of large and small MESCs at-reactor, plus storing the MESCs on-site, is 2.6 person-rem/cask. Use of ALARA techniques reduces the exposure to 1.5 person-rem/cask.

Large and small non-transportable MESCs retrieved from storage, returned to pool, cut open, and SNF transferred to rail and truck transportation casks for shipment to an MRS

Retrieving MESCs from on-site storage for shipment to the MRS facility requires the reverse of the operations in Table A2-3, Steps 1 through 5 and Steps 11 through 13, which result in a worker exposure of 2.1 person-rem/cask, without an adjustment downward for decay. Application of ALARA techniques could reduce the exposure to 1.5 person-rem/cask. The cask-to-cask, instorage delay, while decay acted, is conservatively assumed to be zero. Cutting open the MESC lid is expected to result in the same or slightly lower worker exposure, as compared to the welding operations.

A2.4.2 MPC System

Transportation casks in the MPC system are treated in the same way for the purposes of this dose assessment, whether truck, rail, or barge casks, and in this section are shown as though independent of weight. Actual dose rates from the GA-4 transportation cask are used to estimate the transportation cask handling exposures, and these dose rates are assumed to be representative of any type of existing transportation casks. Transportation cask dose rates are limited by 10 CFR 71. The GA-4 transportation cask dose rates compare favorably to 10 CFR 71 dose rate limits. Representative 24 element storage casks are used to estimate typical dose rates for the MPC transfer operations and dose rates for the MPC storage operations. The TN-24P, MC-10, and NUHOMS-24 storage casks are assumed to be representative. The dose rate profiles representing transportation casks and storage casks are used throughout to estimate the SNF handling related occupational exposures at utilities.

Several components make up the utility SNF transfer and storage operations for MPCs. Some utilities receive MPCs, transfer SNF to these MPCs directly in their pools, and ship the loaded MPCs to the MRS facility. Some MPCs may be transferred to and from on-site storage facilities. Other utilities can transfer fuel from a local type cask to the MPC/Transportation cask for shipment to the MRS/MPC facility. Finally, various utilities will not be able to handle MPCs at all, for whatever reason, so bare fuel will be transferred to transportation casks for shipment to the MRS facility, similar to the methods used in the reference scenario. The MPC cask handling operations are summarized in Tables A2-3 through A2-5. Scenarios 1/2 represent cask handling steps required for the receipt of MPCs at utilities and for the transfer of fuel from the spent fuel pool or ISFSI to the MPCs. Scenario 3 represents a cask to cask transfer.

Scenario 3 differs from Scenario 1/2 because a transfer cask is loaded in the spent fuel pool and moved to a cask-to-cask transfer area. In the transfer area, the fuel is transferred from the transfer cask to the MPC. This operation is repeated until the MPC is full. In Scenarios 1 through 3, MPCs can be moved to on-site storage or retrieved from on-site storage for transfer to the MRS/MPC facility or the MGDS facility.

Scenario 4 was established for cask operations at utilities that cannot handle MPCs, or be modified to do so. In Scenario 4, spent nuclear fuel is transferred from the spent fuel pool to a transportation cask for transfer to an MRS facility or to the MGDS facility.

Truck, Rail, or Barge Transportation Cask Loaded in Pool at Reactors and Shipped to the MRS/MPC Facility or MGDS Facility

Truck, rail, and barge transportation casks are represented by the GA-4 transportation cask dose rate profiles since all transportation casks must meet the dose rate limits of 10 CFR 71. The dose profiles are assumed to be the same for all transportation casks. The dose rate profiles for the GA-4 cask include data at the surface, 1 and 2 meters. The dose rates are applied at the working distances for each step. Dose rates for distances at 10 feet in this section are taken from the 2-meter distance on the dose rate profile. Dose rates at 2 feet are assumed to be the surface dose rate.

Dose rates for the 24 element cask include side dose rates at 1 and 2 meters, in addition to surface dose rates. Where dose rates at 2 feet are needed, surface dose rates are used. At 10 feet, 2 meter dose rates are used. Thus, the storage yard was assumed to have a working area dose rate of 11 mrem/hr, based on the 2 meter dose rate for the 24 element cask. The 11 mrem/hr was used for ISFSIs and the MRS facility storage yard. In the spreadsheets, the working area doses were separated into a direct dose, and a background dose, with the result that the total dose rate remained at 11 mrem/hr in the ISFSI and MRS facility storage yards.

Welding operations are assumed to be performed using a remote controlled welder. The largest exposure to workers is during setting up the remote welding equipment. Also, a flagman is assumed to be used for directing crane operations, during actions where the crane operator's visibility of the object being moved is reduced.

Some operations involve only unloaded or empty casks. "Unloaded" implies that the cask was loaded previously, but does not hold fuel at the present time. "Empty" implies that the cask was never loaded with SNF. In either case, no dose is incurred by workers during the transportation cask or MPC operations. Other operations are performed by machines at the canisters or casks and controlled remotely, so no people are near the casks and no dose is received by workers.

Table A2-4 identifies the steps of Scenario 1/2, for dose assessment. Steps 1 through 6 of the handling operations relate to transportation cask loading and preparation for shipping to the MRS or MGDS facility. Scenario 1/2 begins with the receipt of an empty MPC at the utility. The MPC is loaded into a transportation cask and put in the spent fuel pool for fuel loading. The SNF loading is controlled remotely. Once the fuel is loaded, the cask lids are installed and preparations are made to load the transportation cask onto the off-site vehicle that takes the cask to the MRS or the MGDS facility. A summary of the dose received by workers for each step of the operations is listed below. The application of ALARA dose reduction procedures, discussed previously, could result in a dose of 0.7 person-rem/cask for this scenario.

Table A2-4. MPC Load by Cask-to-Cask and Prepare to Ship

Handling Operations	Exposure () ALARA	person-rem) Nominal
1. Empty MPC received in Prep area	0	0
2. MPC loaded into transportation cask	0	0
3. MPC/cask loaded into utility's spent fuel pool	0	0
4. SNF loaded into MPC/cask	0.01	0.01
5. Loaded MPC/cask moved from pool to Prep area	0.5	1.5
6. Loaded MPC/cask moved from Prep area to gate	<u>0.2</u>	<u>0.2</u>
Total exposure per cask	0.7	1.7

A2.4.3 MPC Loaded by Cask-to-Cask Transfer and Shipped

The same assumptions concerning dose rates for the transportation and 24 element casks established in the previous section apply for cask-to-cask transfer operation steps.

Scenario 3 deals with transfer of SNF to a MPC outside of the spent fuel pool, by using a shielded transfer canister and a cask-to-cask transfer exclusively. The detailed operational steps for this scenario are shown in Table A2-4. In this scenario, the on-site transfer cask is moved into the pool Prep area. The on-site transfer cask is prepared and placed in the spent fuel pool. The SNF is loaded into the on-site transfer cask by remote controlled operations. The loaded transfer cask is moved back into the pool prep area. The on-site transfer cask is moved from the pool Prep area to the cask-to-cask transfer area, for the SNF transfer to the MPC. In addition, an unloaded MPC has been received at the utility for this step.

The MPC is moved to the cask-to-cask transfer area. Steps 1 through 6 of Table A2-5 and Steps 7 through 9 are the operations to prepare the on-site transfer cask and the MPC for fuel transfer. Step 10 describes the actual cask-to-cask transfer. Step 10 involves moving the SNF from the on-site transfer cask to the MPC by a cask-to-cask transfer method. For this dose assessment, these operations are assumed to yield a dose of 1.0 person-rem/cask to workers.

Once the MPC is loaded, the loaded off-site transportation cask is moved to the gate area for the final check out, before moving from the utility site. Steps 12 and 13 include the operational steps to move the loaded on-site MPC transfer cask from the cask-to-cask transfer area to the ISFSI, at the utility. The off-site transportation cask is moved into the ISFSI area to retrieve the MPC for transport to the MRS or MGDS facility, as described in Steps 14 through 16.

The exposure received by workers during the cask-to-cask transfer operations occurs during three activities: 1) SNF transfer from the on-site transfer cask to the MPC/transport cask; 2) MPC storage in the ISFSI, from the cask-to-cask transfer area; and, 3) MPC retrieval from the ISFSI for shipment off-site. The cask-to-cask transfer dose estimate is summarized below. The application of ALARA dose reduction procedures, discussed previously, could result in a dose of 1.5 person-rem/cask for Steps 1 through 11.

Table A2-5. MPC Load by Cask-to Cask and Prepare to Ship

Handling Operations		Exposure (person-rem)	
Handin	<u>COporations</u>	ALARA	Nominal
1.	Transfer cask moved from cask-to-cask transfer area tepper area	to pool	0
2.	Transfer cask moved from pool Prep into spent fuel p	oool 0	0
3.	SNF loaded into the transfer cask	0.01	0.01
4.	Loaded on-site transfer cask moved to pool Prep area	0.2	0.4
5.	Loaded on-site transfer cask from pool Prep to cask-transfer area	o-cask 0.1	0.1

6.	Unloaded off-site MPC transportation cask moved into cask-to-cask Prep area	0	0
10.	SNF transferred from transfer cask to MPC/cask	1.0	1.0
<u>11.</u>	Loaded off-site transportation cask moved to gate	<u>0.2</u>	<u>0.2</u>
Tota	l exposure/cask	1.5	1.7
	•		
<u>Han</u>	dling Operations (2) (ALARA and Nominal)	Exposur	<u>e</u>
12.	Prepare loaded on-site MPC transfer cask for move to ISFSI	0.2	
<u>13.</u>	Loaded on-site MPC transfer cask moved to ISFSI	<u>0.4</u>	
Tota	al exposure/cask	0.6	
Han	dling Operations (3) (ALARA and Nominal)	Exposur	<u>:e</u>
		0.1	
14.	Unloaded off-site MPC transportation cask receipt to ISFSI	0.1	
15.	MPC transfer to off-site transportation cask	0.5	
<u>16.</u>	Loaded transportation cask moved from ISFSI to gate	<u>0.3</u>	
Tot	al exposure/cask	0.9	

A2.4.4 MPC Loaded at the Utility and Placed in On-Site Storage

Scenario 1/2 provided in Table A2-3 also encompasses MPC storage at the utility site after the MPC has been loaded in the spent fuel pool at the utility. Steps 7 and 8 of this scenario, included in Table A2-4 (extended), describe the operational steps involved in placing the MPC into storage. The dose incurred by workers loading the MPC is 1.7 person-rem/cask as discussed earlier in Steps 1 through 6. If the MPC is stored on site, then Steps 7 and 8 contribute to the dose. Once the MPC is loaded, it is prepared and moved to the ISFSI area for on-site storage. The MPC is transferred to the on-site storage facility. The transporter is prepared for movement back to the protected area. The added dose was 0.6 person-rem, for on-site storage of an MPC.

A2.4.5 MPC Retrieved from On-Site Storage and Shipped Off-Site

Steps 9 and 10 of Table A2-4 involve the receipt of an unloaded on-site transfer cask and an unloaded transportation cask to the prep area, and result in a 0.054 person-rem dose to workers. Steps 11 through 13 of Table A2-4 list the operational steps required to retrieve the MPC from an on-site ISFSI to be shipped off-site. The off-site transportation cask is moved to the ISFSI as described in Step 12. The MPC is transferred to the off-site transportation cask. The off-site transportation cask is moved to the gate for a final check-out before leaving the utility site. The dose estimated for retrieving a MPC from on-site storage is one person-rem. No ALARA reductions were shown for these steps.

TABLE A2-4. (extended)

	Exposure (person-rem)
Handling Operations	(person-rem)
1-6. Loading a MPC	1.7
7. Loaded on-site MPC transfer cask prep for ISFSI	0.2
8. Loaded MPC transferred to ISFSI	<u>0.4</u>
Total exposure/cask	2.3
Handling Operations	Exposure
9-10. Receive unloaded transfer cask and transport cask 11. MPC transfer to off-site transportation cask	0.054 0.6
12. Unloaded off-site transportation cask moved to ISFSI	0.1
13. Loaded off-transportation cask moved from ISFSI to gate	<u>0.3</u>
Total exposure/cask	1.0

A2.4.6 SNF Loaded into Transportation Cask at Utility for Shipment Off-Site

Scenario 4 of the utility SNF transfer and storage operations, Table A2-6, was developed to estimate the dose for the utilities that cannot accommodate MPCs and cannot be modified to handle MPCs. In the scenario, a transportation cask is received at the utility and sent to the Prep area. The transportation cask is prepared and lowered into the spent fuel pool. The SNF is remotely loaded into the transportation cask. The transportation cask is removed from the pool. The cask lids are installed in the Prep area. Then the transportation cask is secured to the off-site prime mover and moved to the gate. The application of ALARA dose reduction procedures could result in a dose of 0.2 person-rem/cask.

Table A2-6. MRS, SNF Load and Prepare to Ship Exposures

Handling Operations		Exposure (person-rem) ALARA Nominal	
		110, 110.	
1.	Unloaded off-site SNF transportation cask moved to Prepare	area 0	0
2.	Off-site transportation cask moved to the spent fuel pool	0	0
3.	SNF loaded into the off-site transportation cask	0.0	02 0.002
4	Loaded off-site transportation cask moved from pool, to P	гер	
4.	area	0.1	0.3
<u>5.</u>	Move loaded off-site transportation cask from Prep area to	gate 0.1	0.1
To	tal exposure/cask	0.2	0.4

A2.5 MRS FACILITY

A2.5.1 Reference Scenario

Refer to the MRS CDR, Reference 1, for the details about the basis of the reference scenario dose assessment. The reference scenario dose estimates were updated to reflect more details of handling operations for transportation and storage casks so that the comparison of the original reference scenario and the MPC system will be more accurate.

A2.5.2 MPC System

The MPC system involves more varied operational steps than the reference scenario. A discussion of the scenarios for the handling of MPCs follows. The reduced exposures in steps where ALARA techniques could be applied during lid installation operations are shown in the tables.

A2.5.2.1 SNF Transferred to Large MPC and Placed in Storage at the MRS

The GA-4 transportation cask and the 24 element cask dose rate profiles are used in the MRS/MPC facility dose assessment for the generic transportation cask and the MPC/Storage cask, respectively. The assumptions stated previously concerning the remote operations, crane operations, and storage yard working dose rates are the same for the MRS facility. The operational steps for the bare SNF transfer concept are identified in Table A2-6. The bare SNF transfer at the MRS begins with the receipt of a loaded transportation cask. The loaded transportation cask is inspected, surveyed, and prepared for movement into the transfer cell area. An empty storage cask is brought into the transfer cell area and mated with the cell port.

The SNF is remotely offloaded into the lag storage area until the lag storage contains a full MPC load of SNF. The SNF is taken out of the lag storage area and placed into an MPC/storage cask. The storage cask is unmated from the transfer cell port and moved into the welding area of the bare SNF transfer facility for lid installation and welding. The unloaded transportation cask is moved into the dispatch area. The transportation cask is then prepared to be shipped to another utility to pick up bare SNF. The steps are listed in Table A2-7. The application of ALARA dose reduction procedures could result in a dose of 1.4 person-rem/cask for this scenario.

Table A2-7. MRS, SNF Transfer and Storage Exposures

Handling Operations Expe		Exposu	sure(person-rem)	
			ALARA	Nominal
·1.	Loaded transportation cask received to bare SNF tranfacility	sfer	0.3	0.8
2.	Empty MPC/storage cask moved into the bare SNF transfer facility		0	0
3.	SNF loaded into the MPC/storage cask		0	0
4.	Transportation cask lid is inspected		0	0
5.	Loaded MPC/storage cask moved to the facility stora yard	ge	0.6	1.8
<u>6.</u>	Unloaded truck moved from transfer cell to dispatch	агеа	<u>0</u>	<u>O</u>
To	tal exposure/cask		0.9	2.6
Tal	ble 7. Step 9; Loaded rail cask moved from Prep to Dispatch -MGDS		0.5	<u>0.5</u>
To	tal exposure/cask		1.4	3.1

A2.5.2.2 MPC Arrives at MRS and Stored in the Storage Yard

Most utilities will be capable of handling a large or small type of MPC. In these cases, MPCs will arrive at the MRS to be transferred to the facility storage yard for storage until shipment to the MGDS, later. Table A2-8.1 gives a description of the operations and exposures.

Transportation casks are received at the MRS MPC transfer area. Preparations are made in order to move the MPC/transportation cask into the MPC transfer room, as described in Step 1. An empty storage cask is moved into the transfer room and prepared for the receipt of a MPC. The loaded MPC is transferred from the transportation cask to the storage cask by remote operations once the area is cleared. The loaded storage cask is then moved from the MPC transfer room to the storage yard. The unloaded transportation cask is then moved to the dispatch area and prepared for shipment to another utility to pick up SNF. A summary, Table A2-8, follows. The application of ALARA dose reduction procedures, discussed previously, could result in a dose of 1.1 person-rem/cask for this scenario.

Table A2-8.1. MRS, Cask Arrival and Storage

Handling Ope	<u>E</u>	xposure(person ALARA	-rem) Nominal
1.	Loaded rail transportation cask received at the MRS facility MPC transfer room	0.4	0.7
2.	Empty storage cask moved to the MPC transfer room	n 0	0
3.	MPC is loaded and checked for contamination	0.1	0.1
4.	Loaded MPC/storage cask is moved from the MPC transfer room to the storage yard	0.6	0.8
5.	Rail transportation cask moved to the dispatch area preparations are made for shipment to another utility	and $\underline{0}$	<u>0</u>
Tota	l exposure/cask	1.1	1.6
	Table A2-8.2. Cask Preparation for Ship	ment ALARA	Nominal
6.	Loaded MPC/storage cask moved from MRS facility storage yard to the MPC transfer room	y 0.7	0.7
7.	Unloaded rail transportation cask received and move MPC transfer room	ed to the 0	0
8.	Loaded MPC prepared and transferred to the rail transportation cask	0.1	0.1
9.	Loaded rail transportation moved from cask prep are dispatch	ea to 0.5	0.7
<u>10.</u>	Unloaded storage cask moved back to MRS storage	<u>yard</u> <u>0.1</u>	<u>0.1</u>
Tota	al exposure/cask	1.4	1.6

A2.5.2.3 Bare SNF Transferred to MPC and Shipped to MGDS

Table A2-7, Steps 1 through 6 were discussed previously and refer to bare SNF transfer to a MPC in the MRS facility transfer cell. The dose estimate for this operation is about 0.8 person-rem/cask to the point of loading a MPC, excluding the exposure during the movement of a loaded MPC to the storage yard, which takes place in Steps 4 through 6 of Table A2-7. Welding the MPC closed results in a dose of 1.3 person-rem/cask. Assuming SNF was loaded into a MPC, then Table A2-8.2, Step 9 describes an additional operational step for preparing a loaded MPC for shipment off-site. The exposure for preparing a loaded MPC for shipment to the MGDS is approximately 0.9 person-rem/cask. The total dose received by workers for moving bare fuel from a transportation cask to a MPC and preparing the MPC for shipment off-site is 3.0 person-rem/cask.

A2.5.2.4 MPC Arrives at MRS Facility for Shipment to MGDS

Table A2-8.2, Step 9 contains the steps necessary to prepare a loaded MPC/transportation cask for shipment to the MGDS. If the MRS facility is only being used as a check point for the MPC/transportation cask between the utility and the MGDS, then the steps involved in checking the MPC/transportation cask are identical to those in Step 9 of Table A2-8.2. Therefore, the exposure received by workers surveying the cask for transportation is about 0.06 person-rem/cask. No dose reductions were foreseeable from use of ALARA procedures.

A2.5.2.5 MPC Retrieved from MRS Facility Storage Yard for Shipment to MGDS

The next scenario in the MRS/MPC system considers the retrieval of a MPC/storage cask from the MRS facility storage yard for shipment to the MGDS. In the scenario, a loaded MFC is moved from the storage yard to the MPC transfer room. An unloaded rail transforation cask is also moved into the MPC transfer room. The storage cask and the rail transportation cask are prepared for MPC transfer. The loaded MPC is transferred from the storage cask to the transportation cask. The loaded rail transportation cask is surveyed and prepared for shipment to the MGDS. The unloaded storage cask is moved back to the MRS facility storage yard. Table A2-8 Steps 6 through 10 describe these operational steps. The dose estimate follows. The application of ALARA dose reduction procedures, discussed previously, could result in a dose of 1.4 person-rem/cask for this scenario.

A2.6 CASK MAINTENANCE FACILITY

A2.6.1 Reference Scenario

The Cask Maintenance Facility (CMF) personnel clean the transportation cask, install spacer grids, and clean the fuel storage baskets, if necessary. The cleaning operations are performed underwater, in a pool. Some of the transportation cask internals as well as the cask interior will require cleaning to remove radioactive crud. The amount of crud will vary because each fuel assembly has unique characteristics that influence the amount of crud produced.

Since some of the cleaning operations are performed in a pool, the dose rate from the crud on the baskets or spacers is reduced. Each cask will be handled without SNF in the cask. Each truck cask and rail cask in the active fleet each year is handled at the CMF at least 3 times. Handling the truck casks and rail casks is assumed to result in the same exposure to personnel. The dose for each transportation and rail cask handled at the CMF was assumed to be 20 personmrem/cask on the average, for all cask handling operations. The estimate is based on cleaning and maintenance operations on the casks. Table A2-9 summarizes the exposures.

Table A2-9. Reference Scenario Exposures at CMF

Cask type	Dose per cask
	(person-mrem/cask)
Truck	20
Rail	20

A2.6.2 MPC System

Truck casks used for handling bare SNF, and rail casks used for handling MPCs, will be handled at the MPC system CMF at least three times per year. The dose for each truck cask is higher than the rail dose due to the probable need to clean and maintain internal structures of truck casks. Rail casks and canisters receive only an external cleaning. Each transportation cask and each rail cask handled at the CMF is assumed to be 20 person-mrem/cask on the average for all cask handling operations at the CMF. The value was based on the use of pool operations for cleaning the cask, and other maintenance operations on the cask. Exposures are summarized in Table A2-10.

Table A2-10. MPC System Exposures at CMF

Cask type	Dose per cask
	(person-mrem/cask)
Truck	20
Rail	5

A2.7 REFERENCES

- Monitored Retrievable Storage (MRS) Facility Conceptual Report, Volumes 1 3, November 30, 1992, U. S. D.O.E. Office of Civilian Radioactive Waste Management, Washington, D.C., Contract Number DE-AC01-91RW00134, CRWMS M&O Document Number TSO.92.0323.0257.
- 2. The TN-24P PWR Spent Fuel Storage Cask: Testing and Analyses, EPRI N-5128, April 1987, Pacific Northwest Laboratory, Virginia Power Company, and EG&G, Idaho National Engineering Laboratory.
- 3. The MC-10 PWR Spent Fuel Storage Cask: Testing and Analyses, EPRI N-5268, July 1987, Pacific Northwest Laboratory, Virginia Power Company, and EG&G, Idaho National Engineering Laboratory.
- GA-4 Legal Weight Truck From Reactor Spent Fuel Shipping Cask, Final Design Report, November 1991, General Atomics Project 3462, U. S. D.O.E. Contract Number DE-AC07-881D12698.
- 5. GA-9 Legal Weight Truck From Reactor Spent Fuel Shipping Cask, Final Design Report, December 1991, General Atomics Project 3462, U. S. D.O.E. Contract Number DE-AC07-881D12698.
- 6 "Use of Transportable Storage Casks in the Waste Management System," Appendix (P.A-2), December 1987, ORNL/SUB/86-SA094/2 (or JAI-289).

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APPENDIX B TRANSPORTATION MODE CHARACTERISTICS

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TRANSPORTATION MODE CHARACTERISTICS

These tables support health and safety evaluations of truck, rail, barge, and heavy-haul transport. Parameters shown with the value "route" receive the a value obtained from HIGHWAY or INTERLINE.

Table B-1. Truck Transportation

Input Parameter	Value	
Population density	route	people/sq.km
Fraction Rural Travel	route	decimal
Fraction Suburban Travel	route	decimal
Fraction Urban Travel	route	decimal
Velocity, rural	97	km/hr
Velocity, suburban	80	km/hr
Velocity, urban	64	km/hr
Crew number	2	•
Avg. distance from crew to cask	10	meters
Number of handlings	0	-
Stop time (inspections, meals, etc.)	.0031	hr/km
Minimum stop time	0	hr
Distance independent rail stop time	0	hr
Minimum number of rail inspections	0	-
People near cask during stops	50	-
Average radius to people during stops	50	m
Storage time, en route	0	hr
Number of people nearby during storage	0	-
Average distance, storage, cask to people	0	m
Number of people per vehicle on road	1.2	-
Urban rush hour travel, fraction	0	-
Urban surface street travel, fraction	0	-
Rural and suburban routes on freeway	1	-
One way rural traffic count	470	vehicles/hr

Table B-1. Truck Transportation (continued)

One way suburban traffic count	780	vehicles/hr
One way urban traffic count	2800	vehicles/hr

Accident rates

(reported incidents per million kilometers)

rural	.20
suburban	.28
urban	.36

Probabilities

Accident Severity category	Rural	<u>Suburban</u>	<u>Urban</u>
1	.603	.603	.603
2	.39146	.39145	.3936
3	.00386	.00386	.003399
4	.001675	.001679	.00000048
5	.000003	.000006	.00000038
6	.000002	.000005	.00000014

Table B-2. Dedicated Rail Transportation

Cask Type: Rail Cask

Input Parameter	Value	
Population density	route	people/sq.km
Fraction Rural Travel	route	decimal
Fraction Suburban Travel	route	decimal
Fraction Urban Travel	route	decimal
Velocity, rural	43.4	km/hr
Velocity, suburban	32	km/hr
Velocity, urban	24	km/hr
Crew number, while moving	4.5	-
Average distance from crew to cask	152	meters
Handlers	0	-
Stop time (inspections, meals, etc.)	.004	hr/km
Minimum stop time	0	hr
Distance independent rail stop time	2.75	hr
Minimum number of rail inspections	0	-
People near cask during stops	fixed	- suburban population density
Average radius to people during stops	fixed	- 800 m
Storage time, en route	0	hr
Number of people nearby during storage	0	•
Average distance, storage, cask to people	0	m
Number of people per vehicle on road	3	•
Urban rush hour travel, fraction	0	-
Urban surface street travel, fraction	0	-
Rural and suburban routes on freeway	0	•
One way rural traffic count	1	vehicles/hr
One way suburban traffic count	5	vehicles/hr
One way urban traffic count	5	vehicles/hr

Table B-2. Dedicated Rail Transportation (continued)

Cask Type: Rail Cask

Accident rates

(reported incidents per million kilometers)

rural	1.6
suburban	1.7
urban	3.4

Probabilities

Accident Severity category	Rural	Suburban	<u>Urban</u>
1	.602	.602	.605
2	.39142	.39162	.3948
3	.00453	.00522	.000199
4	.00125	.001139	.00000048
5	.00059	.000016	.00000038
6	.00021	.000005	.0000014

Table B-3. Barge Transportation

Cask type: Large Rail cask

		•
Input Parameter	Value	
Population density	route	people/sq.km
Fraction Rural Travel	route	decimal
Fraction Suburban Travel	route	decimal
Fraction Urban Travel	route	decimal
Velocity, rural	11	km/hr
Velocity, suburban	8.1	km/hr
Velocity, urban	3.2	km/hr
Crew number	5	(3 persons/tugboat + 2 barge handlers)
Avg. distance from crew to casks	46	meters
Handlers	0	•
Stop time (inspections, meals, etc.)	0	hr/km
Minimum stop time	0	hr
Load time for 3 casks	0	hr
Minimum number rail inspections	0	-
People near during loading	0	-
Average radius to people, load & unload	1	m
Time to unload 3 casks from barge	0	hr
Number of people during unloading	0	-
Avg. distance to people during unloading	0	m
Number of people per nearby barge/boat	3	-
Rush hour travel, fraction	0	-
Urban surface street travel, fraction	0	-
One way rural traffic count	0	vehicles/hr
One way suburban traffic count	1	vehicles/hr
One way urban traffic count	0	vehicles/hr

Table B-3. Barge Transportation (continued)

Cask type: Large Rail cask

Accident rates

(reported incidents per million kilometers)

nıral	3.82
suburban	4.24
urban	4.56

Probabilities

Accident Severity category Rural Suburban Urba	<u>n</u>
1 .604 .604 .604	
2 .39596 .39595 .395	5
3 .000037 .000047 .0000	3997
.000001 .000001 .000	0001
·	0001
	0001

Table B-4. Heavy-Haul Truck Transportation

Cask type: Large Rail

Input Parameter	<u>Value</u>	
Population density	route	people/sq.km
Fraction Rural Travel	route	decimal
Fraction Suburban Travel	route	decimal
Fraction Urban Travel	route	decimal
Velocity, rural	16	km/hr
Velocity, suburban	8	km/hr
Velocity, urban	3	km/hr
Crew number, while moving	3	-
Average distance from crew to cask	25	meters
Handlers	0	-
Stop time (inspections, meals, etc.)	0	hr/km
Minimum stop time	0	hr
Start and afloat time	0	hr
Minimum number rail inspections	0	•
People near stopped unit, en route	0	-
Avg radius to people during stops en route	1	m
Time for cask afloat	0	hr
Number of people during afloat	0	-
Avg. distance to people, during afloat	0	m
Number of people per on-link vehicle	1.2	-
Rush hour travel, fraction	0	•
Urban surface street travel, fraction	0	-
Freeway fraction	1	-
One way rural traffic count	2	vehicles/hr
One way suburban traffic count	4	vehicles/hr
One way urban traffic count	6	vehicles/hr

Table B-4. Heavy-Haul Truck Transportation (continued)

Cask type: Large Rail

Accident rates

(reported incidents per million kilometers)

rural	.35
suburban	.003
urban	.003

Probabilities

Accident Severity category	<u>Rural</u>	Suburban	<u>Urban</u>
1	.604	.604	.604
2	.39599	.39599	.395999
3	.0000097	.0000097	.00000097
4	.0000001	.0000001	.00000001
5	.0000001	.0000001	.00000001
6	.0000001	.0000001	.00000001

APPENDIX C
ISOTOPES LIST

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ISOTOPES LIST

This isotopes list was prepared from the "Characteristics Data Base" computer files dated June 23, 1993. The spent fuel characteristics assumed are a PWR assembly with an initial enrichment of 3.75 weight percent, a burnup of 40,000 MWD/MTIHM, and an age (decay) of 10 years after discharge from a reactor.

<u>Isotope</u>	curies/MTIHM
H-3	517
Co-60	2,550
Kr-85	5,670
Sr-90	68,500
Ru-106	1,140
Sb-125	1,460
Cs-134	7,400
Cs-137	191,000
Pm-147	9,160
Eu-154	5,670
Eu-155	2,110
Pu-238	4,180
Pu-240	580
Pu-241	95,300
Am-241	2,140
Cm-244	281

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APPENDIX D MGDS HEALTH AND SAFETY IMPACTS

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MGDS HEALTH AND SAFETY IMPACTS

D.1 METHOD

Expert knowledge and experience data were tailored and applied for the estimation of health and safety impacts at Yucca Mountain, NV. The criteria used in selecting the specific routine and incident impacts for evaluation were the impact types (plausibility), probability, potential severity, radiological release, consequences, and mitigation.

Screening of potential incidents used the data, procedures, and results from Reference 66. The largest off-site dose was calculated to be 220 mrem, which was less than the 500 mrem value used to define items important to safety in 10 CFR 60. Uncertainties however, warrant further clarification as design details are established.

External events that can initiate accidents were identified and screened into several groups: 1) external events, 2) foreseeable conditions or stresses with impact considered within the "design-basis," 3) events not applicable or not credible, 4) events without significant radiological or injuries/fatalities consequences, and 5) events beyond the scope of this document. A brief list of major items follows in Table D-1.

Table D-1. Incidents List

External Events:

Earthquakes, sandstorm, high wind, surface flooding, loss of off-site power, undetected geologic features (joints)

Design Basis Conditions

Thermal loading
Waste and rock interaction
Rock deformation
Geochemical alteration

Events Beyond Scope

Orogenic diastrophism (mountain building)
Military accidents (such as aircraft impacts near Nellis AFL, NV)
Sabotage (employee or terrorist)

Events Not Applicable to Yucca Mountain, NV or Not Credible
(probability of event less than 10⁶ in the operational phase of the program)
volcanic activity
commercial aircraft crash
hurricanes
forest fires
inadvertent intrusion by people
meteorite impact

In a similar manner, the "internal" accident events triggered by on-site people, equipment, or procedures were screened. External initiating events such as earthquakes can combine with internal imitating events or conditions in a way that increases the probability of an event. The results of the evaluation are in Table D-2.

Table D-2. Results of Screening Evaluation

Events Selected for Consideration

Drift collapse (earthquake)

Transporter slide

Transporter runaway (uncontrolled)

Transporter collision

Container failure (design-basis)

Container grapple or hoist failure

Events Combined with Other Initiating Events

Transporter collision with structures, stationary objects, or moving objects were combined as "transporter collision"

All modes of container damage during emplacement or removal of containers were combined as "container failure"

Events that were Not Credible (less than 10⁻⁶ probability of occurrence)

Explosion caused by volatile gases in the underground or surface facility

Collision of waste transporter and explosive truck

Events with Insignificant Radiological Consequences

Failure of lifting system on transporter or in facilities during lift

Explosion or fire at diesel refueling stations

Fire resulting from used oil collection process

Explosion resulting from pressurized gases in welding shops

Mechanical failure of containment system for contaminated water

Accidents due to use of explosives

Rupture of fuel pipes

Rupture of water pipes

Rockfall resulting from structural stress relaxation in drifts and tunnels.

Evaluation of specific impacts and consequences are described in the following sections of the appendix.

D.2 MGDS SURFACE FACILITIES

D.2.1 On-Site

D.2.1.1 Construction

Health and safety impacts during surface facility construction were not evaluated for this document.

D.2.1.2 Operation

During surface site operation, casks will be received, stored temporarily, prepared for emplacement, moved by on-site heavy-haul, and emplaced. Both SNF and HLW may be handled. Operations on individual casks for repackaging, inspection, and other purposes may take place. After cask emplacements cease, a period of monitoring of casks in the underground site will continue, followed by closing of the site. Administrative surface facilities, including security operations, will be on-site. Authorized visitors will be present from time to time. Rough order of magnitude estimates of the exposures for handling, HLW, underground transportation and positioning of waste packages, retrieval inspection, monitoring, and visitors were included in the estimates of overall program routine exposures for completeness. Omission of estimated values of incompletely defined operations was considered to result in a 100 % unconservative error and an appearance that the risks were not recognized, whereas a rough order of magnitude estimate would indicate recognition of risks which can be accurately estimated when better data permit.

D.2.1.2.1 Radiological Impacts During Operational Phase, Only

D.2.1.2.1.1 Routine

D.2.1.2.1.1.1 Occupational

Exposure doses per operation were based on MRS data. The total exposures were the product of the exposure per operation multiplied by the logistics data. The logistics data describe the numbers of casks and fuel assemblies handled at the MGDS. The main influence of the presence of an MRS in the system was that large rail casks were received in place of truck casks. HLW casks were assumed to be handled like truck casks, since truck casks may have 4 fuel assemblies and the received HLW casks were expected to contain 5 vitrified waste logs. However, since the Characteristics Data Base showed an inventory radiation flux average for HLW of about one third of the flux from design basis SNF, the HLW waste routine occupational doses were scaled down to one third of the doses for handling a similar number of truck casks of SNF.

Emplacement transportation surface movement and underground exposure doses were estimated as roughly 0.0001 person-rem per waste package, assuming a highly automated system and without an approved baseline waste package design, nor an approved on-site transportation method. Use of thin wall metal containers can result in strong local radiation fields, Reference 65, which would potentially warrant considerable automation of the surface and underground transportation. The RADTRAN 4 transportation exposures code was inappropriate for estimation of exposures during underground movement since the absorption and reflection of radiation in tunnels with rock walls are not contained in that code.

D.2.1.2.1.1.2 Visitors

Authorized on-site visitors were assumed to arrive via the facility security and outreach programs. VIP visitors were assumed to be provided focused tour routes and procedures for topics of interest. Outreach programs may offer conducted tours for selected groups. General tourist access was assumed to be limited to a "visitor center" and security post at a public gate. The

vehicle entry gates, (truck or railroad gates), were assumed to be at least 1 km from occupational personnel and public access gates.

Doses were estimated as less than 10 mrem/hr at 2 meters from each cask per NRC requirements. Estimating with a 1/r law for radiation dose attenuation with distance, and a linear source for conservatism, leads to less than 0.1 mrem/hr at 200 meters and less than 0.01 mrem/hr at 2 km from exposed casks.

The following examples were offered. The general visitors were assumed to receive less than 1 mrem per person (equivalent to an exposure during a jet aircraft trip of 2500 miles), assuming one 6-hour visit per person. General visitor totals were assumed as 1000 people per year, and thus these people receive in total less than 1 person-rem/year. Very Important People (VIP) visitors can be offered tours with exposures equivalent roughly to a "medical chest x-ray" (50 mrem) or somewhat less. Doses to 250 VIPs per year could total to 12.5 person-rem. The total dose for visitors was $(1 + 12.5) \times 40 = 540$ person-rem during the forty-year program.

D.2.1.2.1.2 Nonroutine (Incidents)

Screening of initiating incidents was described previously. The largest plausible release was associated with an earthquake induced common mode failure of facility lifting equipment, structures, and radiation alarm and ventilation systems. The combined events probability was estimated as less than 5 x 10⁻⁷ for a potential dose of 100 mrem; (based on Table 8-1 of the reference report). HLW handling incidents were considered to be essentially incapable of radioactive gases releases or comparable releases that are the main potential components of exposures following SNF incidents. Thus the HLW incident release doses were estimated to be negligible, and not shown in the report.

These values were compared to the 10 CFR 100.11 sitting criteria (NRC) maximum permissible exposure of 25 rem for accidents "... of exceedingly low probability of occurrence and low risk ..."; or total dose to the public under special circumstances (DOE order 5400.5) of 500 mrem/yr if the average dose is less than 100 mrem/year.

D.2.1.2.2 Non-Radiological Impacts

The occupational impacts were influenced by the location of the MGDS in desert terrain. Occupational activities during operation are repetitive, and at a steady level of effort. There were no identified significant routine or nonroutine impacts to the public, including on-site authorized visitors.

D.2.1.2.2.1 Occupational Routine and Nonroutine (Incidents)

The occupational impact factors included: noise, dust (mineral and organic), repetitive motion/impact, "traffic" accidents, and frequent large-object handling. Reported accidents were assumed to be typical of nuclear power industry experience, involving human errors in use of tools, etc., and thus estimated on the basis of nuclear power industry injuries and hours lost per million hours worked. Using the industry data, the impacts were estimated as follows.

Ri = accident frequency rate 3.85 per million person-hours worked, in 1992. This rate was reduced by nuclear industry safety programs from 10.5 per million in 1980.

P = personnel work hours for program (assume 500 people, 40 hr/week, 52 weeks/yr, 40 years) = 41.6 million manhours.

Losses = Ri*P implies 160 reportable accidents, conceivably including a fatality, during the operational program.

D.2.2 Public Off-Site Impacts

D.2.2.1 Non-Radiological Impacts

There were no identifiable non-radiological off-site impacts to the public caused by the facility. Impacts connected with transportation were dealt with in that section of the document. Dust, debris, noise and other regulated phenomena that may be generated on the site will be controlled to levels less than permitted by the specifications at the facility perimeters.

D.2.2.2 Radiological Impacts During Operational Phase Only

At the perimeter the maximum emissions and airborne releases to any member of the public was estimated at less than the 10 mrem/year of airborne release permitted by DOE Order 5400.5 and 40 CFR 61.92 (EPA).

For an illustrative estimate: at the primary surface road vehicle gates the estimated rate was less than 0.01 mrem, and for an estimated four vehicles gate-visitors/day, 30 minutes each vehicle: the estimated annual dose would be less than 0.730 person rem/year [less than 10 mrem/hr at 2 meters (per NRC requirements) and use a $1/r^2$ law for radiation dose dilution with distance, $\geq 1 \times 10^{-3}$ mrem/hr at 200 meters and 1 x 10^{-5} mrem/hr at 2 km]. The annual dose would be less than 0.1 per year.

Off-site radiological exposures can only occur following radiological release within the above-ground or underground components of the facility. The probability and severity of such events are described in the on-site radiological incident section. As at nuclear power sites, human error and equipment failure-induced punctures of casks could conceivably permit radioactive gas dispersal off-site extremely diluted. Earthquakes can conceivably induce emissions that reach off-site locations as extremely dilute radioactive gases.

The most plausible release was associated with an earthquake that induced common mode failure of on-site facility lifting equipment, structures, and radiation alarms and ventilation systems. The combined events probability was estimated at 5 x 10⁻⁷ for a potential dose of 100 mrem (based on Table 8-1 of the Reference 66). Table 8-1 of the Reference provided the estimated probabilities and doses for several scenarios, on the access ramps and in the underground sections of the MGDS. Notably the highest probability was 10⁻⁵, for about 100 mrem.

These values were compared to the 10 CFR 100.11 sitting criteria (NRC) maximum permissible exposure of 25 rem for accidents "... of exceedingly low probability of occurrence and low risk ..."; or total dose to the public under special circumstances (DOE order 5400.5) of 500 mrem/yr if the average dose is less than 100 mrem/year.

D.3 MGDS UNDERGROUND

Impacts underground were estimated for operations after the initial waste emplacement capability was established. Impacts during site preparation, before the first operational emplacements of waste packages, were not considered. Activities conducted underground consisted of continued excavation, emplacement of waste packages, monitoring, backfilling, closure, and the extraction /return of waste packages.

D.3.1 Construction Influence on Operational Safety

Construction (excavation, mapping, and reinforcement) may continue through the life of the facility. Risks were involved in the excavation, installation of structural reinforcement such as rock-bolts and mesh, and during backfilling. Rockfall risks decline rapidly to a steady low rate after the initial excavation at the rock-face, and following structural reinforcement installation at each newly opened section of the works. Continuous monitoring of the ceiling structures by commercially available local rock movement mechanical indicators was assumed to detect and remedy any previously undetected weak positions.

Deformable structural linings in fully lined tunnels will prevent rockfall, except in earthquakes that cause severe collapse of the short sections of the tunnels. Structural reinforcement (lining) with rock-bolts and mesh reinforcement exhibited a largest size of rockfall that was defined by the greatest size ceiling rock pyramid possible between the rock-bolts. Probability of a rockfall happening will depend on the local rock quality index (spacing between fracture lines), method of construction, span of the tunnel, time since excavation of the section, and factors such as earthquakes. The cumulative probability of a rockfall increased with tunnel length, if all other factors remained fixed.

Well designed and installed reinforcement mesh attached to the tunnel walls can reduce the severity of rockfalls if the loose rock fragments exceed the mesh size, and if the total weight of the rockfall is below the rip-out capacity of the mesh attachments to the tunnel rock roof and walls. Weak rock areas will be mapped and reinforced. Undetected weaknesses are a plausible risk, and can be minimized by advance inspection technologies, up to levels triggered only by major seismic disturbances.

Thermally induced stresses during heat-up can increase the probability of exfoliation-shooting and slabbing. Further, interior cooling of the tunnel drifts can induce rockfall, by reducing clamping forces, especially after stress rheological relaxation flow movement of the tuff.

Statistics from comparable underground facilities were the best basis of meaningful estimates of the frequency and severity of rockfalls. The only known comparable facility is at the National Test Site (NTS). Tunnel sections constructed by tunnel boring machines are most pertinent.

pertinent. Drill-and-blast excavation experience would be very conservative, overestimating the impacts, since the blasting degrades the rock integrity for several meters into the remaining rock wall and roof structure. In contrast, tunnel boring machines damage the rock walls and ceiling only to a thickness (depth) of a few centimeters. There is a high probability of small fragments, up to the size promoted by the depth of damage created by the excavation process, and almost zero probability of fragments larger than the tunnel width.

The factor Ri, the fatal accident frequency rate in conventional metal and nonmetal mines, was reportedly 3 per 10,000 person-hours worked, to the year 1993. Scaling for the smaller working face per worker at the MGDS, compared to mineral extraction mines, provides an exposure factor of about 0.001. Thus P = personnel work hours for the program (assume 50 people underground in potentially hazardous operations, 40 hr/week, 52 weeks/yr, 40 years) = 4.2 million manhours. Losses = Ri*P implies less than one fatal accident, during the operational phases of the program. Reference 71 described the comparative safety records of two tunnels, one driven by tunnel boring machine and the other by conventional drill and blast methods, in the same geology at a single site, about 1965. The lost time accidents per 10,000 feet tunneled was 28 man-days for the machine, and 525 man-days for the conventional method. This is a safety advantage of 525/28, or about 20 times.

D.3.2 Radiological Exposures

Significant exposures are expected during transportation of waste packages to and from the positions in the drifts, orientation placement of each package at its assigned location, and for periodic inspections during the operational period of the MGDS. Each emplacement trip, including a simple in-drift placement, was estimated to provide roughly the same person-mrem. Monitoring of in-situ casks was estimated at one person-mrem per cask per year. These were combined with throughput data to obtain the program life-cycle doses listed in the report. There were no (zero) identified plausible radiological incident releases projected, short of a catastrophic earthquake.

The estimates are based on comparable activities at the utilities and MRS for on-site transportation and dry storage. Estimates are still uncertain because the final designs of the transporter, its shielding, and robotic support (if any) have not yet been selected. Thus the estimates shown in the primary section of the report are rough order of magnitude in accuracy. Clarification will be needed as the designs and procedures are refined.

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MPC Robotic Welding:

Simulation and

Benefit-Cost Analysis Report

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Executive Summary

This report compares the economic and radiation dose impacts of robotic handling methods to those of manual handling methods for closing and welding Multi-Purpose Canisters (MPC). It describes the graphical simulation techniques used to develop and support assumptions for the economic analysis, including the creation and operation of the animated workcell depicting MPC closure operations at a commercial reactor site. This work further describes and utilizes the economic analysis methods recommended by the U.S. Government Office of Management and Budget. The economic analysis uses assumptions based on manual operations defined by TRW Environmental Safety Systems, and robotic operations based on MPC closure simulation, which is in turn validated for robotic equipment in use at Sandia National Laboratories. This report presents the cost and robotic equipment in use at Sandia National Laboratories machinery to traditional manual methods in the MPC closure operations.

The results of this analysis present a compelling case for choosing the robotic method over the baseline manual methods for specific MPC closure and welding operations. The use of robots to execute these operations offers a unique win-win opportunity, simultaneously saving 1538 person-rem and \$52 Million over a 13-year operational period, including developmental costs, as compared to the manual method. Payback is achieved within 26 months of start of operations.

This savings can be accomplished with the potential to more than double the manual through-put rates, matching the manual rates at a minimum. Further, additional MPC operations may be possible using the robotic machinery and controls, and the operational lifetime may be significantly extended, reducing additional radiation dose, through-put time and costs.

Pursuit of the robotic method holds low risk from the economic and technical standpoint. Most of the operations have been demonstrated individually, simulations indicate high-success probability, and the potential savings of \$52 Million is significant. Even should the entire \$52 Million be used to cover cost increases, cost of additional units and demonstration work, essentially free person-rem savings would remain "reasonable" from the ALARA standpoint.

Therefore, if no preferable alternative is found, robotic closure and welding operations should be pursued and demonstrated for application at commercial reactor sites, as well as any other sites where MPCs are loaded.

MPC Robotic Welding: Simulation and Benefit-Cost Analysis Report

1.0 Introduction

This work is sponsored by the U.S. Department of Energy (DOE) and TRW Environmental Safety Systems (TESS), the DOE Management and Operating contractor for the Civilian Radioactive Waste Management System (CRWMS). The purpose of this report is to provide decision information to determine whether robotic methods are a viable option to reduce radiation exposure during Multi-Purpose Canister (MPC) closure and welding operations. The MPC is a sealed metallic canister intended for storage, transportation and disposal of spent nuclear fuel (SNF) assemblies throughout the CRWMS. MPCs are sealed to provide a dry, inert environment for SNF and are overpacked separately and uniquely for the various system elements of storage, transportation, and geologic disposal. Closure of the MPCs results in a significant dose to personnel using traditional manual means, and alternate methods are desirable. Robotic manipulators offer a means of completing the closure operations without the presence of radiation workers, and an opportunity to reduce radiation doses for each robotic operation by up to 88%. Therefore, information regarding technical feasibility, operational speed, dose savings and cost are needed to compare potential robotic MPC operations to manual counterparts, and determine whether to pursue robotic application.

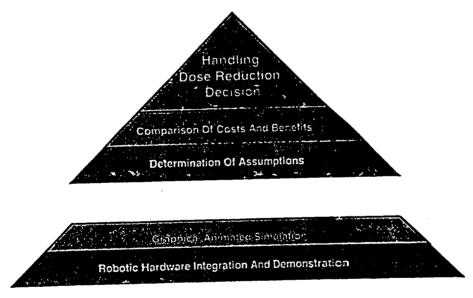


Figure 1.1 MPC closure and welding method decision process.

Figure 1.1 illustrates the steps needed to support the decision process. The first step is a comparison of costs and benefits for each radiation reduction method proposed. Underlying the cost/benefit analysis of each method are the assumptions, including dose rates, labor costs, capital costs, through-put rates, etc.

This effort seeks to support the assumptions used for robotic operations by adding the two elements in the lower part of the pyramid in Figure 1.1. Graphical animated simulation is extensively used at Sandia National Laboratories (SNL) as a part of general robot control

systems. That is, graphical models of the robot and its environment are generated and used for both preview and real-time control of robot motions. For this reason, all graphical models of the robots in use at SNL have been validated. Further, many of the closure operations required for the MPC have been demonstrated at SNL using robots with the graphical programming capability. Thus, confidence in robotic assumptions for the cost/benefit analysis is high.

This report compares the economic and radiation dose impacts of robotic handling methods to those of manual handling methods for closing and welding Multi-Purpose Canisters (MPC). It describes the graphical simulation techniques used to develop and support assumptions for the economic analysis, including the creation and operation of the animated workcell depicting MPC closure operations at a commercial reactor site. This report further describes the economic analysis methods used, inputs to the economic analysis, and presents the costs and benefits of using robotic machinery in lieu of traditional manual methods in the MPC closure operations.

Robotic handling cost estimates are based upon graphical simulations of a workcell in generic fuel handing building at a commercial nuclear reactor site. The simulation uses software which accurately models the dimensional and kinematic characteristics of the robots, facility, casks, and ancillary equipment. The simulation identifies operations that can be automated with robotic machinery, examine how those operations can be executed automatically, identify equipment requirements and operational characteristics for the automation, and determine potential process times for each automated operation. Equipment cost is estimated based on identified requirements.

Manual handling cost estimates are based on process timing, dose rates, labor rates and crew size information provided by TESS^{1,10}. Minimum crew size per shift for each workcell is estimated at 3, plus one QA welder for all shifts. Additional crews may be rotated in to avoid exceeding radiation dose limits. Labor costs are then calculated, representing the majority of the manual handling cost.

Economic analysis methods recommended by the U.S. Government Office of Management and Budget are applied to the resulting investment and operating cost estimates to determine lifetime costs. The economic analysis uses assumptions based on manual operations from TESS described above, and robotic operations based on the MPC closure simulation, which is in turn validated for robotic equipment in use at SNL. Cost and benefit results of the analysis, comparing use of robotic machinery to traditional manual methods in the MPC closure operations are presented and discussed.

2.0 Simulation Description

Modeling and simulation are executed using IGRIP software from Deneb Robotics, Inc., on SiliconGraphics workstations. IGRIP is used to accurately model the dimensional and kinematic characteristics of the robots, facility, casks, and ancillary equipment. Embedded into this modeling is a high degree of component detail with programmable machine parameters to match most commercially available robotic systems. This accuracy, together with previous validation of the IGRIP modeling environment and its integration into real-with previous of SNL industrial robot systems², leads to high-confidence estimates of the through-put of the workcell.

The MPC welding venue chosen for simulation is a generic fuel handling building with a decontamination pit near the fuel storage pool (Figure 2.1). A decontamination pit places the top of the MPC near the floor. This allows robotic equipment and tooling to be mounted near the floor, reducing potential safety hazards and facilitating service and maintenance. Other mounting schemes may be required for those utilities without decontamination pits or with conditions otherwise preventing floor mounting.

A robot is mounted on a mounting plate at the side of the pit, and rotated on the plate into position above the MPC after the MPC has been placed in the pit by the facility crane. The mounting plate footprint is approximately 6 x 6 feet. The robot chosen for this simulation is a Staubli Unimation NEATER 762 robot (Figure 2.2). Based upon the Unimation PUMA 762 industrial robot, the NEATER robot has been engineered for radiation tolerance up to 108 Rads. This is sufficient to survive a continuous field of 200 Rads per hour for 57 years, which eliminates most reliability concerns related to radiation exposure. Though it is not yet clear whether specific radiation hardening is required, this level was assumed to be sufficient for the lifetime dose imparted by the MPC operations, and offers the option of trading the industrial machine for the commercially available and kinematically similar radiation tolerant machine.

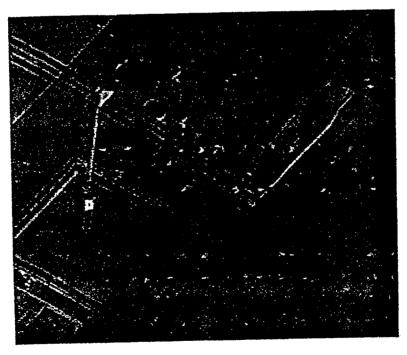


Figure 2.1 Simulated generic fuel handling building with decontamination pit



Figure 2.2 NEATER 762 robot in action. Source: AEA Technology

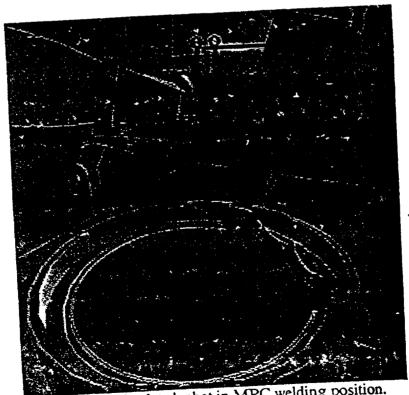


Figure 2.3 Simulated robot in MPC welding position.

The NEATER 762 has a 20 kg load capacity at full extension, with sufficient work volume (verified by simulation) to cover the MPC head area for both inner and outer lid welding when positioned over the MPC. A similar robot has been used by AEA Technologies when positioned over the MPC. A similar robot has been used by AEA Technologies Winfrith to weld intermediate level waste drums closed using a synergic pulsed Metal Inert Gas (MIG) process³. Figure 2.3 shows the simulated NEATER robot in position for MPC closure and welding operations.

To further assure technical feasibility, available technologies, hardware and software are assumed. In particular the SMART control approach, and sensors including capacitive seam tracking and distance measurement, force/torque sensors and machine vision are assumed.

Sequential Modular Control Architecture for Robotics and Teleoperation, or SMART, is a real-time distributed, modular control architecture based on passive network theory that guarantees stability as control modules are added or removed⁴. SMART allows for control strategies to be changed through software or even during operation of a robot through supervisory control. In the MPC case, SMART would allow the welding operator to "take over" from autonomous operations as needed. It also permits use of sensor input for path adjustment such as arc voltage, distance and obstacle detection, and contact forces. SMART modules for robots, sensors, path planners, feed-back mechanisms and graphical control schemes can and have been built and assembled into working control systems. SMART has been implemented and demonstrated to TESS representatives on a PUMA 760 series robot at SNL. This demonstration included program execution of part of the simulation described in this report.

Capacitive sensing is assumed for both seam tracking and path compensation due to warpage. The sensors produce an electric field between appropriately spaced electrodes. These fields are perturbed by the workpiece, resulting in capacitance changes which can be interpreted and utilized for motion control purposes. Several versions of sensors exist. One is used to determine lateral and forward distances to an object. Another is used as a robot "skin," detecting obstacles and preventing collisions. The third, a Multi-Axis Seam robot "skin," detecting obstacles and preventing collisions. The third, a Multi-Axis Seam Tracking (MAST) sensor, has been designed and successfully applied to manufacture Delta rocket booster engines at Rocketdyne⁵. The engines consist of hundreds of specially-shaped tubes brazed together to form a solid assembly. A robot arm scans the surface of the nozzle with a MAST sensor, determines the position and orientation of tubes and seams, and automatically generates paths for braze paste dispensing.

Force/torque sensing and control is assumed for all contact operations. Standard position control relies on the robot moving to a calculated position in space. If that position is intended to be on an object surface, any error in calculation or in robot performance may result in either undesirable force build-up or no contact at all. Therefore, force sensors are used to detect forces and adjust forces applied when robots are operating in contact with objects. Force control is used industrially for grinding and deburring operations. Force control is used extensively at SNL in all robots requiring contact operations on workpieces. Examples of SNL-demonstrated operations where force control is used are nuclear fuel transportation cask swipe surveys and bolting operations, grinding, deburring, pipe cutting, and part assembly and disassembly.

Machine vision is assumed for fast orientation of the robotic equipment to the MPC and lids. Since the robot will be removed from its operating position when lids are installed and then repositioned over the MPC, a means of calibrating the robot movements to the position of the MPC and its components is needed. Machine vision finds three points on the MPC, defining its position and orientation relative to the robot. Each point can be determined in approximately 30 seconds.

Two examples of machine vision use at SNL include spent nuclear fuel transport cask handling and part deburring demonstrations. In an RW-sponsored demonstration, an SNL gantry robot using machine vision located a 1/2 scale transport cask in its workcell with an accuracy of approximately .04 inches⁸. This enabled the subsequent operations of cask inspection, radiation surveys, contamination swiping in contact with the cask, impact limiter removal, tie-down removal and uprighting. In a separate manufacturing demonstration, a crown-shaped part was located and oriented to an ADEPT robot, which then generated a path based on a part CAD model, and used a grinder with force feed-back to remove burrs from the teeth of the crown⁹.

Table 2.1 lists the operations carried out in the simulation by the robot, together with the time required for execution of each operation and a manual comparison from Reference 1. Since 100% velocity may be unacceptable for safety reasons, Table 2.1 includes execution time for the robot moving at 25% of full speed. This combination brackets the range of likely allowable speeds at a reactor site. In each case, it is assumed that no human presence is required in the proximity of the MPC.

Note that Table 2.1 only includes operations expected to be performed by a robot. Other time consuming operations, such as cask loading, unloading, MPC fuel loading, MPC decontamination and MPC lid fit-up are not included. See reference (1) for a complete listing.

The right-column entries in Table 2.1 indicate expected manual operation times provided in (1). Some manual operations, such as repetitions of the NDE processes, were not included in (1). Positioning the robot and locating the MPC are roughly the equivalent of installing the current remote welding device. A significant difference in expected time is in the inner and outer lid welding. While manual operations are expected to take approximately 1000 minutes per weld, robot execution, programmed to move identically to the current welding machine at 8 inches per minute during welding, appears to require only about 385 minutes. Several factors influence this difference.

First, the 1000 minute estimate is based on current operations of an Independent Spent Fuel Storage Installation (ISFSI) at Duke Power's Oconee Station. The ISFSI canister design includes a key way at the side of the canister to accommodate draining and venting ports, resulting in a deviation of the weld from a circular path. Because of the corners thus generated, and the inability of the current remote welding machine to adequately weld these corners, time-consuming manual welding is required in the corners. By contrast, the MPC design has a circular weld path, and the robot manipulator, though capable of key way deviations, is not required to deviate from the circular path.

Table 2.1
Simulated MPC Closure and Welding Operations:
Execution Times and Manual Comparison

Execution Times and I	100% speed	25% speed	Manual Speed
	Task Time (m)	Task Time (m)	Task Time (m)
11 11 11 11 11 11 11 11 11 11 11 11 11			45
1 Install welder	0 23	0.23	
2 Robot positioning	0.5	0.5	
3 Locate MPC	382.1	387.0	1000
4 Inner lid weld	5.5	6.1	
5 Tack weld innner lid	1.5	2.3	22
6 Drain/dry connection operation			30
Inner lid weld NDE inspection	4.4	4.6	
7 Inner lid dye application	2.3	2.6	
8 Inner lid dye removal	1.9	2.0	
9 Inner lid powder application	1.9	2.0	
10 Inner lid camera inspection	5.7	6.0	20
11 Inner lid helium leak check	31.5	31.5	90
12 Port cover welding	0.91	1.6	
13 Port cover installation	+		
Port weld NDE inspection	3.8	4.4	
14 Port cover dye application	6.9	7.2	
15 Port cover dye removal	3.8	4.1	
16 Port cover powder application	0.3	0.5	
17 Port cover visual inspection	9.5	10.0	
18 Port cover helium leak detection	0.5	0.5	45
19 Locate MPC (install welder)	382.1	387.0	1000
20 Outer lid weld	5.4	6.1	
21 Tack weld outer lid			
Outer lid weld NDE inspection	2.33	2.8	30
22 Outer lid dye application	4.46	4.7	
23 Outer lid dye removal	2.28	2.5	1
24 Outer lid powder application	1.87	2.0	
25 Outer lid camera inspection		5.9	
26 Outer lid helium leak detection	5.61 0.19	0.3	20
27 Operations complete (remove weld equipment)		885	2282
Elapsed Time	867	1 003	

Secondly, finish grinding is apparently required prior to NDE testing, and may have been included in the welding time estimate. Finish grinding was not given in Reference (1) specifically, and was not identified as a normal operation for simulation. However, grinding was included as an off-normal event in the simulation. Adding a single grinding pass at the weld speed of 8 inches per minute would add approximately 24 minutes for each weld.

Third, weld tip cleaning is not included in the weld timing analysis, and will increase the simulated timing. It is not clear at this writing how much the frequency or duration of the cleaning process will impact the operational timing, but discussions with welding

equipment vendors are continuing. Additional verification should be made that all necessary welding parameters and subtasks have been addressed. Fourth, the automatic sensors and controls assumed for the robotic system will minimize welding delays.

Finally, even if 1000 minutes is substituted for the 385 minute robotic simulation welding time, the total robotic process time becomes approximately equal to the manual estimate. Figure 2.4 illustrates the inner lid welding in the simulation.

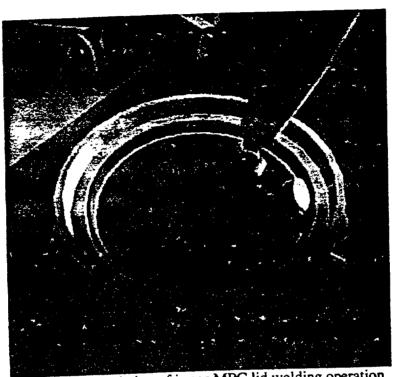


Figure 2.4 Simulation of inner MPC lid welding operation

Drain/dry connection operations include both making and breaking port connections, but does not include the draining, vacuum drying and backfilling operational times for either handling method.

Significant discrepancies between manual and robotic operation time here may be due to equipment design concept differences. For the draining, drying and backfilling process, a quick-release connection mechanism was simulated based on a SNL design and demonstrated in the Cask Head Project⁸. Shown in Figure 2.5, a sleeve containing the female portion of a quick-release valve with ball detents is inserted into the port hole and connected with a simple pushing motion. Release is accomplished by a linear pulling motion. The sleeve has a diamond-shaped pintle attached to the top that is gripped by a specialized diamond gripper commonly used at SNL. A similar pintle was assumed to be attached to the port covers for gripping and placement over the drain and drying ports using the same diamond gripper.

These quick-release mechanisms are cheaper and simpler to use than valves requiring first a physical connection then a valve opening procedure. If the latter valves are used the execution time for this step will rise and tooling complexity increase, possibly quadrupling the cost of this tool.

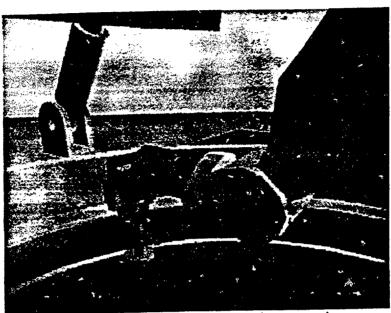


Figure 2.5 Drain/dry port connection operation.

Draining and drying is accomplished in concept by pressurizing the gas port, forcing water through the drain pipe at the MPC bottom up through the drain port and out of the MPC. After the water is removed, any residual water is boiled away using a vacuum process through the same drain and drying ports. Helium is then backfilled into the MPC, providing an inert atmosphere inhibiting corrosion and assisting in heat transfer and leak detection functions.

Upon completion of the draining/drying/backfilling process, the ports are welded closed. First, port covers are emplaced over each of the two ports using the gripper described above. Then the welding rig is brought in to weld the covers in place and provide the primary seal over the valves. All welds are then inspected as described below.

As discussed above, a finish grinding operation may take place after the welds are complete. Though not included in the timing analysis, the approximate time for each weld may be found by dividing the weld circumference by the grinding speed, and adding one minute for tool changes. Grinding speed has been assumed to be equal to the welding speed of 8 inches/minute.

Current weld non-destructive evaluation (NDE) inspection practice at Duke Power Company's Independent Spent Fuel Storage Installation (ISFSI) at the Oconee plant is a three-step dye penetrant test. The test requires the application of dye, removal of excess dye, and the application of a developer. Three separate tools were simulated to execute these tests. The first is a dye applicator that either sprays or brushes dye onto the weld surface. The second is a dryer that blows air across the surface toward a vacuum

attachment on the other side. The third tool is a powder applicator blowing a low-velocity developer powder aerosol onto the weld surface. It is recognized that use of pressurized sprays may not be ideal for the dye penetrant process, as pressure may inadvertently force penetrant from the very cracks and crevasses being sought. However, tooling may be designed to overcome this difficulty such as sponge daubers and low-velocity vacuuming with little anticipated cost difference.

After the welds are inspected and the MPC has been drained, dried and backfilled with helium, a helium leak check is performed to assure hermetic sealing. The helium leak check uses a sniffer wand attached to a mass spectrometer tuned for helium. A sniffer tool, based on a hand-held device, was simulated for this operation. The robot passed the sniffer once over each of the main and port welds at a speed of 0.5 inches/sec.

When inner lid operations are complete, the robot retracts for emplacement and fit-up of the outer lid using the facility crane. The welding and inspection operations described above are then essentially repeated for the outer lid.

One additional set of operations for off-normal weld conditions is simulated. If a bad weld area is detected, the simulation stops, indicates to the operator where the detected flaws were, and asks the operator whether the flaws should be repaired. If the answer is yes, the robot retrieves a grinder and executes the material removal process in the indicated area. Once sufficient material is removed, the weld head applies repair metal, and the NDE process is repeated for the affected areas. Due to rare occurrence and variation in operator choices for this off-normal sequence, timing analysis does not include these operations.

Table 2.2 lists the equipment and associated estimated costs necessary to execute the closure and welding operations robotically as described above, based on SNL experience.

Supervisory control systems represent those systems that coordinate the activities of the robot, welding equipment, sensors and operator interface. The NEATER robot is the articulated manipulator fielding all the welding and sensory equipment. The stereo vision locating system allows the robot to find the MPC within its work volume and thus orient all movement on the MPC. Location must be done each time the robot is moved, such as during inner and outer lid installations when the robot is rotated away from the head of the MPC. Each of the tools necessary for the above operations are listed together with a cost estimate. The welding system was originally quoted by PAR for use with a gantry robot to weld MPCs in an MRS environment. However, Dimetrics has verbally quoted \$70K for a track welding system large enough to weld barrels. If such a system is adequate, the cost would be reduced potentially by half for this item.

The total capital cost for a robotic closure and welding system is approximately \$647 K. The estimated cost for a remote automated welder such as those currently in use at Duke Power Company's Oconee plant and at Baltimore Gas and Electric Company's Calvert Cliffs plant is \$350 K. However, this welder is only capable of making the inner and outer lid welds, where robots are capable of additional dose-saving tasks.

Table 2.2

MPC Closure And Welding Equipment And Cost Estimation

	Est. Unit Cost	Quantity	Cost	Source	Totals
lem					····
supervisory control					
Support computing system	\$17,400	i	\$17,400		
VxWorks real-time operating system	\$22,400	1	\$22,400		
SiliconGraphics workstation	\$45,000		\$ 45,000	SiliconGraphics	
IGRIP graphical programming software	\$60,000		\$60,000	Deneb Robotics	
Auxiliary workstation	\$15,000	1	\$15,000	Sun	44.50.000
Supervisory Subtotal					\$159,800
supervisory debitors					
NEATER 760 Radiation Telerant Robot	\$220,437	1	\$220,437	AEA Technologies	
NEATER 761/2 N robot arm					
Interconects and radiation tolerant adapter box					
Brake release box		<u> </u>			
CS3 VAL controller, VAL II control, I/O module					
Teach pendant					
Disk and manual set			<u> </u>		
Industrial VDT with integral disk drive					
NEATER Robot Subtotal		1			\$220,437
NEATER ROOM SECTOR					
Stereo vision locating system		<u> </u>			
Cohu 6412 cameras	\$1,545	2	\$3,090	Scientific Systems	
25 mm lenses	\$200	2	\$400	Scientific Systems	
VME rack, Force back plane, power 20	\$4,990	11	\$4,990	I M Systems	ļ
CPU-30	\$4,990	1	\$4,990	I M Systems	<u> </u>
Framestore board	\$3,750	1	\$3,750	DATACUBE	
	\$2,250	1	\$2,250	DATACUBE	ļ
Digimax board	\$7,800	1	\$7,800	DATACUBE	ļ
VFIR MKII board	\$1,450	1	\$1,450	DATACUBE	
Max SP board	\$3,000	i	\$3,000	DATACUBE	<u> </u>
SNAP board	\$3,000		\$3,000	DATACUBE	↓ _
Featuremax board					\$34,720
Stereo vision locating system Subtotal					
					
Tools	\$2,000	1	\$2,000	<u> </u>	
Gripper	\$4,000		\$8,000		
Port couplings	\$10,000		\$10,000		
Dye applicator (NDE)	\$10,000		\$10,000		
Dye remover (NDE)	\$10,000		\$10,000		
Dye developer (NDE)	\$5,00		\$5,000		4
Grinder	\$50		\$500		
Port cover holder	\$50		\$2,000		
Tool rack Tools Subtotal			1		\$47,50

Table 2.2 cont.'
MPC Closure And Welding Equipment And Cost Estimation

			1		\$30,000
Mounting Frame					
Cask mounting ring			†		
Robot mounting plate			-		
Robot mounting plate support frame					
Trunnion clamps					
	\$155,000	1	\$155,000	PAR Systems	
Welding system	3133,000				
Automatic Process Control					
APC computer, board and software					
Current sensors			-		
Welding equipment					
Power supply					
Welding controller					
Wire feed and dispenser					
Cabling and hose package					<u> </u>
Torch (MIG)			_		
Cable and hose termination block		 			
Flow switches and controls		 			
Welding equipment brackets		-			
Miscellaneous welding supplies		 			
Services		╁───			
Design					
Test		1			
Documentation		1			
Installation supervision (160 hrs)		+			
Software engineering		-			\$155,00
Welding system subtotal					
					\$647,45

Simulated operations do not include a tip cleaning operation, nor does the list of equipment include a tip cleaning station. Discussions with Dimetrics indicate an absolute need for this procedure and support equipment. Cost figures are not available at this writing, but are expected to fit into the estimated welding system subtotal presented in Table 2.2.

3.0 Economic Analysis Method

The economic analysis method used to compare the robotic and manual handling methods is a Benefit-Cost Analysis using net present value and related outcome measures as defined by the Office of Management and Budget (OMB)¹⁰. All of the known cost drivers required over the life of the project are included in the analysis. Cost drivers consist of the labor, dose, investment, maintenance, and energy costs for the required operations on the MPC. Driver estimates are listed in Table 3.1 as the basic assumptions to determine whether automation is economically advantageous.

Table 3.1
Cost Driver Estimates for MPC Closure and Welding Operations

Assumption	Manual Method	Robotic Method
Project Life (Years)	13	13
Annual Labor Cost (Operator)		\$150,000
NL Operator	\$75,000	\$75,000
Welder	\$75,000	\$75,000
OA Welder	\$75,000	\$75,000
Annual Dose Limit	1	1
Dose Cost per Rem	\$10,000	\$10,000
Discount Rate	3.00%	3.00%
Investment Cost/Unit	\$350,000	\$647,457
Development Costs		\$5,000,000
Robot Maintenance Cost	\$5,000	\$35,000
Computer Maintenance Cost	\$0_	\$3,600
Software Maintenance Cost	\$0	\$9,000
Down Time (%)	0.00%	5.00%
Automated Welding Units	5	5
Energy Cost per KWH	\$0.08	\$0.08
Energy Requirement (kW)	0	10
Weld MPC-125:	 	
Operator dose (mrem/MPC)	193.9	73.4
Welder dose (mrem/MPC)	696.6	
QA welder dose (mrem/MPC	146.6	0
Weld MPC-75:		
Operator dose (mrem/MPC)	193.9	
Welder dose (mrem/MPC)	696.6	
QA welder dose (mrem/MP	d 146.6	0

Project life is assumed to be 13 years based on partial MPC loading schedules provided by TESS¹¹.

Labor cost is the value required for each operator per year. Manual operator rates were provided by TESS¹², and are based on the lower ranges of \$35,000 to \$50,000 per year

times an overhead factor of 2.15 for operators and \$35,000 to \$40,000 per year times an overhead factor of 2.15 for welders. Robotic operators are assumed to have a higher cost than radiation workers and are assumed for this analysis to be at the high end, approximately \$70,000 times the same overhead factor.

The minimum number of individuals required to carry out operations manually for three shifts is six non-licensed (NL) operators, three qualified welders and one QA welder for inspection purposes. In the event robotic machinery is down this minimum crew must be on hand to continue process flow. Once an operator reaches the dose limit for the year, a replacement operator will be required to resume operation. Therefore, more than the minimum number of operators may be required for that particular year.

Radiation dose is a major driver in the cost analysis. As described above, the number of operators required depends upon how many operators reach the annual dose limit. The current regulatory limit is 5 rem/year. However, DOE has set a design goal of 1 rem/year, and lower if possible following the As Low As Reasonably Achievable (ALARA) philosophy. A dose limit of 1 person-rem/year is assumed for consistency with DOE policy. Dose rates are estimated on an MPC basis. Manual dose rates for the 125 ton MPC were determined by TESS¹, and were assumed the same for the 75 ton MPC. Manual operator dose rates in Table 3.1 represent combined rates for all operators. Dose rates for the robotic case are assumed for robotic equipment deployment and based on MPC lid installation rates. Doses imparted during robot down-time are not normal operations and therefore not listed in Table 3.1, however they are considered in the personnel requirement in Table 4.4. Annual and total doses are then found by multiplying the rate and throughput for each MPC. A cost of \$10,000 is applied to each rem imparted to each operator based on the range of industrial values and current TESS practice.

The discount rate of 3% is the nominal discount rate used by TESS to bring all dollars to the present value for comparative purposes.

The investment cost is the capital investment required to implement each handling method, such as buying robotic and computing equipment. The investment values above represent one MPC robotic welding unit. The cost of a remote welding rig for manual handling similar to those used by Duke Power Company and by Baltimore Gas and Electric, quoted by PCI Services, is compared in Table 3.1 to automated handling capital costs of robotic equipment, sensors, supervisory computers and tools. Five units were assumed sufficient to service all MPC-loading utilities in a given year.

Development costs are estimated at \$5 Million, including prototype equipment procurement, system integration and refinement, and demonstrations for all operations.

Maintenance cost is the amount required for a maintenance per year for each method. Here, \$20,000 reflects an estimated annual maintenance contract with AEA Technologies for each robotic machine. Though maintenance contracts have been issued 13 to British Nuclear Fuels Limited for approximately \$6,000, demand for immediate response will likely raise the contract price. An additional \$15,000 is added for maintenance contracts on computer hardware and software.

14

The down time is the expected maintenance and repair time associated with robotic machinery. Since industrial evidence indicates availability of 95% ¹⁴, a down time of 5% was chosen.

An energy cost is also assigned for machine operation based on "Monthly Energy Review." 15 This value is used to determine the energy cost per year by multiplying the power cost times the total power required for each year. Energy requirements represent a difference between manual and robotic methods, ignoring the power required to drive the manual welding machine servo motors.

4.0 MRS/MPC Cost-Benefit Results: Robotic versus Manual Operations

Using the process and cost drivers described above, total cost, differential cost and cost per rem are calculated for comparative purposes. Tables 4.1 through 4.3 examine the manual MPC closure and welding case for operations described above. Table 4.1 describes the expected annual occupational dose to each of the three classes of workers. Table 4.2 determines the number and cost of labor for each of the worker classifications, and Table 4.3 lists expected costs for the manual method. Tables 4.4 through 4.6 repeat the process for the robotic MPC closure and welding method. Table 4.7 examines various economic parameters, concluding with the "pay-back" period expected for the 5-unit robotic scenario.

Table 4.1
Annual Dose Using Manual MPC Closure and Welding Methods

Vear	Loadings of	Loadings of:	Total		Dose to	Personnel	
1 Cai	MPC	MPC	MPCs	Operators	Welders	QA Welders	Total
	125	75		(rem)	(rem)	(rem)	(rem)
							_,
1998	48	22	70	13.6	48.8	10.3	72.6
1999	50	63	113	21.9	78.7	16.6	117.2
2000	84	53	137	26.6	95.4	20.1	142.1
2001	75	69	144	27.9	100.3	21.1	149.3
2002	85	43	128	24.8	89.2	18.8	132.7
2003	86	56	142	27.5	98.9	20.8	147.3
2004	94	22	116	22.5	80.8	17.0	120.3
2005	85	48	133	25.8	92.6	19.5	137.9
2006	107	20	127	24.6	88.5	18.6	131.7
2007	87	37	124	24.0	86.4	18.2	128.6
2008	101	39	140	27.1	97.5	20.5	145.2
2009	90	36	126	24.4	87.8	18.5	130.7
2010	147	40	187	36.3	130.3	27.4	193.9
Totals		548	1687	327.1	1175.2	247.3	1749.6

The MPC loading values in Table 4.1 were provided by TESS⁶ and represent the currently anticipated fuel loading schedule. Radiation doses per MPC from Table 3.1 are multiplied by the number of MPC loadings to determine the dose imparted to each worker classification, then summed for an annual total dose.

In Table 4.2, the required personnel and labor costs are determined by the maximum of the following.

- 1. For each of three shifts and each welding unit, a minimum of two non-licensed operators and one qualified welder is required, totaling six and three, respectively. A minimum of one QA welder per welding unit is required. It is assumed that the QA welder can be scheduled to inspect each weld when it is complete. Thus, with the number of units at five, a minimum of 30 operators, 15 welders and 5 QA welders would be expected.
- 2. If the radiation dose imparted reaches the DOE dose limit, a rotation of workers is required. The relatively high dose rates for welders and QA welders result in higher numbers of these individuals.

Table 4.2
Annual Labor Cost Using Manual MPC Closure and Welding Methods

Veen	Rea	uired Pers	sonnel	Labor Cost					
Year	Operators			Operators	Welders	QA	Total		
	Operators	Weiders	Velders			Welders			
	20	49	11	\$2,250,000	\$3,675,000	\$825,000	\$6,750,000		
1998	30	79	17	\$2,250,000	\$5,925,000	\$1,275,000	\$9,450,000		
1999	30	96	21	\$2,250,000	\$7,200,000	\$1,575,000	\$11,025,000		
2000	30	101	22	\$2,250,000	\$7,575,000	\$1,650,000	\$11,475,000		
2001	30	90	19	\$2.250,000	\$6,750,000	\$1,425,000	\$10,425,000		
2002	30		21	\$2,250,000	\$7,425,000	\$1,575,000	\$11,250,000		
2003	30	99	18	\$2,250,000	\$6,075,000	\$1,350,000	\$9,675,000		
2004	30	81	20	\$2,250,000	\$6,975,000	\$1,500,000	\$10,725,000		
2005	30	93	19	\$2,250,000	\$6,675,000	\$1,425,000	\$10,350,000		
2006	30	89		\$2,250,000	\$6,525,000	\$1,425,000	\$10,200,000		
2007	30	87	19	\$2,250,000	\$7,350,000	\$1,575,000	\$11,175,000		
2008		98	21	\$2,250,000	\$6,600,000	\$1,425,000	\$10,275,000		
2009		88	19	\$2,775,000	\$9,825,000	\$2,100,000	\$14,700,000		
2010	37_	131	28	32,773,000	\$7,025,000	1 42,200,000	<u> </u>		

Annual labor costs are determined by multiplying the labor rates listed in Table 3.1 by the number of workers determined in Table 4.2, and summing the three products. It is assumed that each worker is paid full annual salary, whether or not the individual's radiation dose limit has been reached.

Table 4.3
Annual List of Costs Using Manual MPC Closure and Welding Methods

Year	Labor	Dose	Energy	Maintenance	Investment	Total	Discount Factor	
	Cost	Cost	Cost	Cost	Cost	Cost		Cost
0					\$1,750,000	\$1,750.000	1	\$1,750,000
- 1	\$6,750,000	\$725,970	\$0	\$25,000	0	\$7,500,970	0.9853	\$7,390,925
2	\$9,450,000	\$1,171,923	\$0	\$25,000	0	\$10,646_923	0.9566	\$10,185,170
3	\$11,025,000	\$1,420,827	\$0	\$25,000	0	\$12,47C_\$27	0.9288	\$11,582,497
4	\$11,475,000	\$1,493,424	\$0	\$25,000	0	\$12,993,424	0.9017	\$11,716,377
5	\$10,425,000	\$1,327,488	\$0	\$25,000	0	\$11,777.488	მ.8755	\$10,310,629
6	\$11,250,000	\$1,472,682	\$0	\$25,000	. 0	\$12,747.682	0.8500	\$10,834,939
	\$9,675,000	\$1,203,036	\$0	\$25,000	0	\$10,903,036	0.8252	\$8,997,161
8	\$10,725,000	\$1,379,343	\$0	\$25,000	0	\$12,129_343	0.8012	\$9.717.579
9	\$10,350,000	\$1,317,117	\$0	\$25,000	0	\$11,692,117	0.7778	\$9,094,456
10	\$10,390,000	\$1,286,004	\$0	\$25,000	0	\$11,511,004	0.7552	\$8,692 ,798
11	\$11,175,000	\$1,451,940	\$0	\$25,000	0	\$12,651,940	0.7332	\$9,276,118
12	\$10,275,000	\$1,306,746	\$0	\$25,000	0	\$11,606.746	0.7118	\$8,261,947
		\$1,939,377	50	\$25,000	0	\$16.664.377	0.6911	\$11,516.586
13 Totals	\$14,700,000 \$137,475,000	\$17,495,877	50		\$1,750,000	\$157,045,877		\$129,327,183

Table 4.3 lists the costs associated with manual MPC closure and welding operations. Labor costs are drawn directly from Table 4.2. Dose costs are determined by the product of the total annual dose imparted (Table 4.1) and the cost per person-rem in Table 3.1. Energy costs are assumed to be negligible since the same welding power supply is expected for both the remote manual and robotic welding units. Annual maintenance contracts for each of the welding units results in the maintenance figures. Investment costs are unit cost times the number of units drawn from Table 3.1. These costs are summed for total cost, and discounted according to the OMB procedure referenced in Section 3 to determine an annual present value cost.

Annual doses imparted using robotic MPC closure and welding methods are listed in Table 4.4. Doses are determined in a similar manner to those in Table 4.1, with the exception that only 12% of the dose found in Table 4.1 is imparted. This is due to the absence of workers in the MPC vicinity except during installation and during the 5% down time of the robotic machines. It is assumed that the workers manually execute operations during such down time. However, it is unlikely that the welders would personally weld the MPCs due to the high radiation dose rates involved. Either the robotic machinery would be repaired and robotic welding continued, or a remote manual unit could be installed. Costs for the latter case have not been considered in this analysis.

Table 4.4
Annual Dose Using Robotic MPC Closure and Welding Methods

			Total	Dose to Personnel						
Year	Loadings of: MPC 125	Loadings of: MPC 75	Total	Robot Operators (rem)	Operators (rem)	Welders (rem)	QA Welders (rem)	Total (rem)		
			70	0	5.8	2.4	0.5	8.8		
1998	48	22	70	0	9.4	3.9	0.8	14.2		
1999	50	63	113	1 0	11.4	4.8	1.0	17.2		
2000	84	53	137	1 0	12.0	5.0	1.1	18.0		
2001	75	69	144		10.6	4,5	0.9	16.0		
2002	85	43	128	0 0	11.8	4.9	1.0	17.8		
2003	86	56	142		9.6	4.0	0.9	14.5		
2004	94	22	116	0	11.1	4.6	1.0	16.		
2005	85	48	133	0	10.6	4.4	0.9	15.9		
2006	107	20	127	0	10.3	4.3	0.9	15.		
2007	87	37	124	0	11.6	4.9	1.0	17.		
2008	101	39	140	0	10.5	4.4	0.9	15.		
2009	90	36	126	0	15.5	6.5	1.4	23.		
2010	147	40	187	0	13.3	58.8	12.4	211		
Totals		548	1687		140.2	1 50.0	.1			

Table 4.5
Annual Labor Cost Using Robotic MPC Closure and Welding Methods

					Labor Costs				
Year			Personnel		Operators	Welders	QA	Robot Operators	Total
	Operators	Welders		Robot Operators	Ориши		Welders		
			Welders		\$2,250,000	\$1,125,000	\$375,000	\$2,250,000	\$6,000,000
1998	30	15	5	15		\$1,125,000	\$375,000	\$2,250,000	\$6,000,000
1999	30	15	5	15	\$2,250,000	\$1,125,000	\$375,000	\$2,250,000	\$6,000,000
2000	30	15	5	15		\$1,125,000	\$375,000	\$2,250,000	\$6,000,000
2001	30	15	5	15			\$375,000	\$2,250,000	\$6,000,000
	30	15	5	15	\$2,250,000	\$1,125,000	\$375,000	\$2,250,000	\$6,000,000
2002		15	5	15				\$2,250,000	\$6,000,000
2003	30	15	5	15	V		\$375,000	\$2,250,000	\$6,000,000
2004	30	15	5	15	\$2,250,000	\$1,125,000	\$375,000		\$6,000,00
2005	30		+	15	\$2,250,000	\$1,125,000	\$375,000		\$6,000,00
2006		15	1-3-	15	\$2,250,000		\$375,000		
2007	30	15	1	15	\$2,250,000	\$1,125,000	\$375,000		\$6,000,000
2008	30	15	5	15	\$2,250,000		\$375,000		\$6,000,00
2009	30	15	5		\$2,250.000			\$2,250,000	\$6,000,00
2010	30	15	5	15	34,430.040	14.1.201000			

Table 4.5 lists the expected annual labor costs for robotic MPC closure and welding operations. The required workers are the minimum described under Table 4.2, due to the low doses imparted during robotic operations. Labor costs are therefore driven by minimum crew needs and not by radiation doses and limits.

Table 4.6
Annual List of Costs Using Robotic MPC Closure and Welding Methods

Year	Labor	Dose	Energy	Maintenance	Investment	Total	Discount Factor	Discounted
	Cost	Cost	Cost	Cost	Cost	Cost		Cost
					\$8,237,287	\$8,237,287	 	\$8,237,287
0	06.000.000	107.670	\$60,800	\$187,600	0	\$6,336,079	0.9853	\$6,243,124
2	\$6,000,000 \$6,000,000	\$87,679 \$141,538	\$60,800	\$187,600	- 6	\$6,289,938	0.9566	\$6,112.809
3	\$6,000,000	\$171,599	\$60,800	\$187,600	0	\$6,419,999	0.9288	\$5,962,686
4	\$6,000,000	\$180,367	\$60,800	\$187,600	0	\$6,428,767	0.9017	\$5,796,921
5	\$6,000,000	\$160,326	\$60,800	\$187,600	0	\$6,408,726	0.8753	\$5,610,534
6	\$6.000,000	\$177,862	\$60,800	\$187,600	0	\$6,426,262	0.8500	\$5,462,025
7	\$6,000,000	\$145,296	\$60,800	\$187,600	0	\$6,393,696	0.8252	\$5,276,063
8	\$6,000,000	\$156,589	\$60,800	\$187,600	<u> </u>	\$6,414,989	0.8012	\$5,139,451
9	\$6,000,000	\$159,074	\$60,800	\$187,600	0	\$6,407,474 \$6,403,716	0.7778 0.7552	\$4,983,913 \$4,835,913
10	\$6,000,000	\$155,316	\$60,800	\$187,600 \$187,600	C	\$6,423,710 \$6,423,757	0.7332	\$4,709,754
11	\$6,000,000	\$175,357 \$157,821	\$60,800 \$60,800	\$187,600	0	\$6,406,221	0.7118	\$4,560,095
12	\$6,000,000 \$6,000,000	\$234,227	\$60,800	\$187,600	0	\$6,482,627	0.6911	\$4,480,079
Totals	\$78,000,000	\$2,113,052	\$790,400	\$2,438,800	\$8,237,287	\$83,342,252		\$69,1 73 ,367

Annual costs for the robotic method are listed in Table 4.6. Labor costs are drawn directly from Table 4.5. Dose costs are determined by the product of the total annual dose imparted (Table 4.4) and the cost per person-rem in Table 3.1. Energy costs are calculated by multiplying the robot power requirement and kilowatt charge listed in Table 3.1, and 16,000 hours of annual operation. This represents three shifts of 2000 hours at 10 kW (60,000 kW-h) for the robot itself, and an additional 100,000 kW-h for computer and sensor operations. Also drawn from Table 3.1 are investment costs and annual maintenance contracts for each of the welding units resulting in the maintenance figures. These costs are summed for total cost, and discounted according to the OMB procedure referenced in Section 3 to determine an annual present value cost.

Table 4.7 provides cost comparative numbers as outlined by the OMB. For each successive year of information provided, the total costs are drawn from Tables 4.3 and 4.6, and subtracted to find differential costs between manual and robotic MPC closure and welding methods. In this case, the differential costs represent a significant annual savings by using robotic methods. Results are shown in graphical form in Figure 4.1.

Table 4.7
Differential Cost For Manual And Robotic Methods

		Т	Differential	Discount	Discounted	Cumulative	Investment/	Cumulative
Year	Annual Costs	Annual Costs	Differential	Factor	Differential	Differential	Differential	Amortization
		Robotic Method	Costs	0.9853	\$1,147,802	\$1,147,802	5.65192271	1.00
	\$7,500,970	\$6,336,079	\$1,164,892	0.9566		\$5,220,163	1.24273646	2.00
2	\$10,646,923	\$6,389,938	\$4,256,985	0.9388		\$10,839,974	0.59845961	2.12
3	\$12,470,827	\$6,419,999	\$6,050,828	0.9017		\$16,759,429	0.38708279	റ.00
4	\$12,993,424	\$6,428,767	\$6,564,657	0.8755		\$21,459,524	0.30230338	0.00
5	\$11,777,488	\$6,408,726	\$5,368,762	0.8500		\$26,832,438	0.24177030	0.00
6	\$12,747,682	\$6,426,262	\$6,321,420	0.8252		\$30,553,535	0.21232523	0.00
7	\$10,903,036	\$6,393,696	\$4,509,340	0.8232		\$35,131,663	0.18465640	0.00
8	\$12,129,343	\$6,414,989	\$5,714,354			\$39,242,207	0.16531401	0.00
9	\$11,692,117	\$6,407,474	\$5,284,643	0.7778 0.7552		\$43.099,092	0.15052026	0.00
10	\$11,511,004	\$6,403,716	\$5,107.288	0.7332		\$47,665,456	0.13610038	0.00
11	\$12,651,940	\$6,423,757	\$6,228,183			\$51,367,308	0.12629213	0.00
12	\$11,606,746	\$6,406,221	\$5,200,525			\$58,403,815	0.11107642	0.00
13	\$16,664,377	\$6,482,627	\$10,181,750	0.6911	37,030,307	1 450, 705,010		<u> </u>

To bring the differential costs into present value (1994) dollars, a discount factor is calculated and multiplied by the differential cost to determine the discounted differential. The discount factor (DF) is calculated using the following equation:

For example,

The cumulative differential is then tracked through each year of operation, resulting in an operational cost savings of \$52 Million in 1994 Dollars at the end of year 13, or the year 2010. Note that the differential cost and the discounted differential cost does not include the investment costs required for each method.

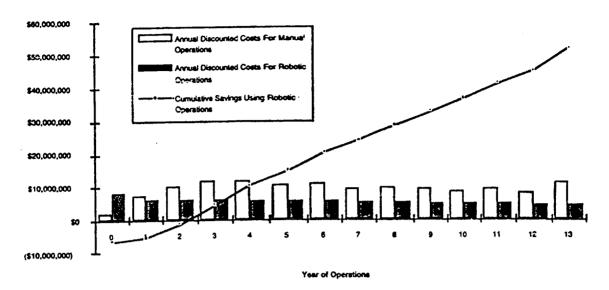


Figure 4.1 Economic Analysis Results: Robotic versus Manual MPC Welding and Closure Operations

Table 4.8 summarizes the comparison results. Total savings using the robotic method is determined by subtracting the investment differential from the cumulative differential, resulting in over \$52 Million in savings over the manual method.

Table 4.8
Summary of Automated MPC Closure/Welding Operations
Cost/Benefit Analysis

Total Cost for Manual Method	\$157,045,877
Total Cost for Robotic Method	\$ 91,579,538
Discounted Cost for Manual Method	\$129,327,183
Discounted Cost for Robotic Method	\$77,410,654
Differential Cost Manual to Robotic	\$71,953,625
Discounted Differential Cost Manual to Robotic	\$58,403,815
Differential Investment Cost	\$6,487,287
Total Cost (Savings) for the Project Life	(\$51,916,529)
Amortization (Years)	2.12
Dose Savings for the Project Life (rem)	1538.28
Cost (Savings) per Rem for the Project Life	(\$33,750)

The amortization is the time in years required to "pay back" the investment based on the annual discounted savings. To determine the amortization, the difference in total capital investment between manual and robotic equipment is divided by the cumulative differential operating costs (Investment/Differential column). The total difference in investment cost is

the difference between the robotic and manual welding equipment times the number of units, all shown in Table 3.1. The result in this analysis is a payback in 2.12 years, or within approximately 25.5 months of operation.

Total lifetime dose savings for the robotic operations considered is approximately 1538 person-rem.

An additional figure of merit by which to judge the workcell potential for automation is the cost or savings per rem eliminated. This number is recommended by the International Commission on Radiation Protection to determine whether a radiation protection measure is economically feasible. Dividing the lifetime operational dose savings by the lifetime total cost yields a savings of \$33,750 per person-rem.

5.0 Discussion

This effort presents a workable robotic solution to MPC closure and welding operations. However, the simulation basis is not optimized and several additional points should be addressed about the analysis and its assumptions.

First, using a dexterous robotic manipulator to execute the examined operations yields an opportunity to automate still more operations, saving the associated doses. Some of the possibilities are enumerated in Table 5.1. Table 5.1 indicates elimination of nearly 293 additional person-rem per MPC may be possible using the robotic manipulator for the operations listed.

Secondly, several questions arise about the use of the NEATER robot. First, it is not clear at this writing that the radiation tolerant NEATER robot is required to perform the necessary operations. A survey of parts of its industrial PUMA counterpart should be conducted to determine if the PUMA could perform the required MPC tasks satisfactorily. If so, the cost of the robot could be cut by 50%, or about \$100,000 each.

The second question, regarding mounting the NEATER, is potentially more serious regarding the simulation executed for this effort. Although initial inquiries into the horizontal mounting of a NEATER such that the work volume suited the MPC head operations yielded no concerns, later simulation demonstrations and discussions with AEA Technology representatives resulted in a concern about performance of the bearings in joint number 1, which is the waist bearing. This bearing is designed for mounting of the robot in a vertical or inverted position. Mounting of the NEATER in a horizontal position as required for sufficient reach, shown in Figure 2.3, may result in reduced performance and payload capacity, both undesirable results that may hinder execution of many robotic closure and welding operations.

Table 5.1
Possible Additional Robotic Operations

Potential Added Operations	Manual Time	Manual Dose
• • • • • • • • • • • • • • • • • • • •	Estimate	Estimate
	(minutes)	(person-mrem)
Remove annulus seal	12	
Operator		26.9
Operator		26.9
Check for contamination	30	
Rad Protection		9.9
Rad Protection		9.9
Install annulus welding protection	12	<u> </u>
Operator	<u> </u>	26.9
Operator		26.9
Remove annulus welding protection	12	
Operator		14.7
Operator		14.7
Perform HP survey	45	
Rad Protection		19.7
Rad Protection		19.7
Secure cask bolted lid	30	
Operator		48.5
Operator		48.5
TOTAL Additional Potential	141	292.7

Discussions with TESS have also included concerns about mounting a robot on the floor of a fuel handling building by anchoring into the floor. Possible solutions include a gantry-type mounting, where the robot is suspended in an inverted position over the MPC, whether the MPC is in a decontamination pit or in sitting on the fuel handling building floor. This would solve the joint 1 bearing difficulties in the NEATER, but it is not clear that in this orientation the NEATER would have sufficient reach to execute full-circle welding operations. A second possibility is to mount the robot directly over the MPC on a frame that attaches to the cask itself. The cost estimate includes this possibility.

Other radiation tolerant robot manipulators are commercially available that may satisfy the welding requirements. Two alternative robots are supplied by AEA Technology: The NEATER 660 (\$210,000) and the NEATER 860 (\$270,000). Both have sufficient work volume to perform MPC operations, both have improved payload capacity over the NEATER 760 series examined here, and both can be mounted in any orientation. Neither has an industrial-grade (non-radiation-hardened) counterpart, and neither has been tested in a welding environment nor using the SNL control systems. Schilling Development, Inc., offers HELIOS (\$295,000), a radiation tolerant, electric robot alternative. It also has superior reach and payload capacity, and can be mounted in any orientation. HELIOS has not been tested in a welding application, but Schilling is familiar with the SNL approach to control systems and offers the ability to link to current systems.

A third general question regarding the simulation is the performance of NDE on the MPC welds. As mentioned in Section 2, the expected means of NDE is a three-step dye penetrant examination. First, if dye penetrant methods are used, other possibilities such as a two-step procedure may be desirable, reducing the number of steps and tools required to execute the operation. Such a procedure may also reduce the time required to execute the examination manually and reduce the number of QA welders required annually, and thus the associated labor costs.

Second, an NDE concern was raised by TESS that the simulated spray tooling may adversely impact the dye penetrant by inadvertently blowing the dye from the very cracks and crevasses the test is intended to detect. While non-contact operations may be preferable to contact operations for compliance and positional error reasons, contact is routinely made under sensory control and daub/roil-on tools for applying and removing excess dye and developers can be assumed. Such tools are likely as simple as the spray tools and approximately the same size. Thus, the simulation, though showing non-contact weld NDE, is valid for contact tools.

The third NDE question is that of possible alternatives to dye penetrant tests. Autoradiography, with sufficient columnation, filtering and shielding, may be a viable, non-contact alternative. Using autoradiography, it may be possible for sensors to image the welds in real-time, and more quickly than dye penetrant testing. Depending on ultimate inspection requirements, this or other alternatives may be used to detect sub-surface cracks and voids in MPC welds.

A fourth general question for discussion is the choice of assumptions and their impacts. Changing dose limits to 5 person-rem/year in Table 3.1 results in a 13-year cost of approximately \$43.5 Million to implement robotic welding. This equates to a cost of approximately \$28,000 per person-rem. However, as suggested above, it is assumed that DOE design goals are maintained and a 1 person-rem/year limit is imposed on a DOE-designed system, and that the5 person-rem/year limit is not applicable.

It is possible that the welders could be used in the robotic handling case as the robotic operators. This is the case for operation of the current remote welding machines, and would eliminate the need for the robot operator position. Changing the welder's labor rate to the equivalent of the robot operators results in a 13-year savings of approximately \$64.1 Million, or a savings of \$41,643 per person-rem.

In this analysis it is assumed that the crew members were paid annual salary charged to MPC loading whether individuals have reached the dose limits or not. Another approach would be to assign labor costs to MPC loading only for those hours specific to the skills required. Assuming a 1-week turn-around per MPC and that all crew members are needed during that week, a 13-year cost savings of \$1.7 Million could be realized, or a savings of \$1,117 per person-rem. This savings is independent of dose rate. However, these assumptions constitute rotation of crews, which is counter to DOE design guidelines. Further, it is reasonable to assume full-time crews traveling with each welding unit, particularly welders and robotic operators, who require special training. Such an arrangement could not be accomplished by paying partial salaries.

A final general point of discussion is the choice of five welding units to serve the utilities loading MPCs each year. Current loading schedules will result in 19 sites loading MPCs in 1998, 24 sites in 1999, 11 sites in 2000, 9 sites in 2001, 5 sites in 2002, and 7 sites in 2003. This schedule is subject to change based on utility and DOE action, and is therefore a relatively unreliable basis for choice of welding unit copies. It is assumed that the welding units are portable and can serve three to five sites each year. It is further assumed that satisfactory utility site scheduling can be achieved to make this possible. A basis of 5 units was therefore chosen for cost analysis purposes, but since this choice impacts the final economic numbers, further clarification of unit needs should be undertaken.

6.0 Conclusions and Recommendations

The results of this analysis present a compelling case for choosing the robotic method over the baseline manual methods for MPC closure and welding operations. The use of robots to execute these operations offers a unique win-win opportunity, simultaneously saving 1538 person-rem and \$52 Million over a 13-year operational period, as compared to the manual method.

This savings can be accomplished with the potential to more than double the manual through-put rates, matching the manual rates at a minimum. Further, additional MPC operations may be possible using the robotic machinery and controls, and the operational lifetime may be significantly extended, reducing additional radiation dose, through-put time and costs.

Such results are highly consistent with the ALARA philosophy of reducing radiation doses "as low as reasonably achievable," since savings in both dose and costs, while maintaining or improving through-put must be considered reasonable.

These results should be compared to other operational alternatives, such as manual operations using movable shielding and long-handled tools. However, such alternatives generally do not improve through-put, nor do they reduce radiation doses as significantly as removal of the operator from the radiation field. However, personnel requirements may be reduced, resulting in lower labor costs than the baseline manual method, and equipment requirements may be reduced with respect to the robotic method, resulting in lower capital costs.

Pursuit of the robotic method holds low risk from the economic and technical standpoint. Most of the operations have been demonstrated individually, simulations indicate high-success probability, and the potential savings of \$52 Million is significant. Even should the entire \$52 Million be used to cover cost increases, cost of additional units and demonstration work, essentially free person-rem savings would remain "reasonable" from the ALARA standpoint.

Therefore, if no preferable alternative is found, robotic closure and welding operations should be pursued and demonstrated for application at commercial reactor sites, as well as any other sites where MPCs are loaded.

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ALARA Benefits of an MPC Robotic Welding System

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Summary

The potential occupational exposure savings for a robotic welding system for the MPC system as described in the Sandia Report (ref. 1) could be as much as 900 mili-person-Rem (mpR) for a single MPC loaded to a storage system or to a transportation cask. For the entire DOE MPC system this could reduce the at-reactor exposure by as much as 9,600 person-Rem for the full 86,000 metric tons of projected commercial spent fuel inventory over a 33 year time period. The system may also be applied to other canister welding operations and to the waste package closure operations at the MGDS. It is also projected to decrease the time to perform welding operations and to utilize far fewer qualified welders and operating personnel. This reduction in occupational exposure would reduce the at-reactor portion of the MPC system exposure to a value less than that for the reference system. (See Table 3-1 in the Health and Safety report, reference 2)

Current Reference System

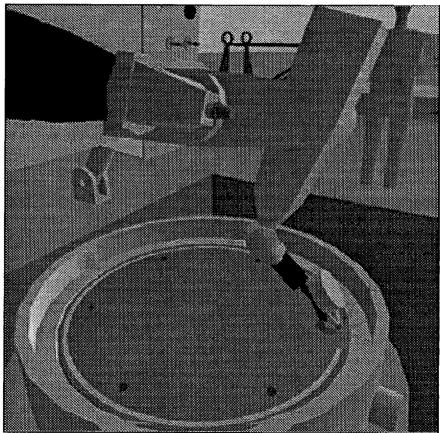
The current occupational exposure estimates for the reference MPC system assume the use of the semi-automated welding system utilized in current at-reactor dry storage systems with welded closures. Welding operations include the following operations:

- Temporary radiation protection shielding installation,
- · Welding equipment set-up,
- · Inner and outer lid welding,
- Non-destructive examination (NDE) preparation (weld slag grinding),
- · NDE including dye penetrant and helium leak tests,
- · Weld repairs,
- · Equipment and shielding removal.

These activities associated with canister closure operations account for approximately 50% of at-reactor dry storage occupational exposures.

Robotic System

The use of a fully automated robotic arm with the appropriate computer controlled supervision as shown in figure 1 from the Sandia National Lab report could substantially reduce at-reactor occupational exposures. The robotic system uses a commercially available robotic arm with the appropriate degrees of freedom and work area for the MPC lid welding operations. The system is furnished with the appropriate end-effectors necessary to perform the functions for all welding operations as described above. The computer control system developed at Sandia National Labs is designed to support fully automated or fully manual operations. That is, a qualified welder and weld inspector may need only to view via a CCTV the operations performed by the robot and interrupt action if necessary or the welder may take total control of the system at any time to fully control the robot and end-effector. The integration of the robotic arm and the computer controlled system for these welding operations is unique for this type of application.



MPC Robotic Welding System Simulation

Figure 1

An additional advantage of this robotic welding system is its ability to provide support for other operations. The flexibility of the system allows for the capability to perform NDE, remove a poor quality weld and re-weld over a small area needing repair. The inherent dexterity of the system also allows for welding in corners and tight curved spaces as in the area around the canister drain and vent ports or for the valve covers. These are areas where welding is currently performed manually and are responsible for a large percentage of the normal operating exposures.

ALARA Justification

The estimated cost of the system is \$5 million for development and demonstration of the system and \$650K for each system. This is compared to about \$350K for the existing semi-automated system. Engineering development includes design of the welding equipment and other end-effectors to be integral to the robotic arm and the design of the control system to assure the capabilty to perform all welding operations. The demonstration includes all welding equipment, the robotic arm , NDE equipment and a setup of the top portion of the MPC lid and shell. A mockup of the transport cask may be necessary to demonstrate the support system design.

The combination of the robotic arm and the computer software controls that are specialized for the function of ASME certified welding at each purchaser site presents a unique challenge for the system and its developers. Engineering development and system demonstration are necessary to assure safe and reliable operation for MPC program acceptance. At \$10,000 per person-Rem saved, this system could be worth more than \$3,000,000 per year in exposure savings alone. For individual annual exposure limits of 1 person Rem, the required number of welders and operating personnel can be reduced based on the reduced exposure. This will result in savings of approximately \$4,000,000 per year.

An additional issue is associated with the availability of sufficient qualified welders for the current reference system. To keep individual exposures below 1 person-Rem per year for each individual, more than 300 additional qualified welders would be necessary to support the OCRWM MPC program at the steady state SNF acceptance rate. This impact would significantly impact the demand and potential cost of this work group.

Other Advantages

Another potential advantage of the development of the robotic welding system is in its application to other dry storage welded canister storage systems. The demonstration of the principle of robotic welding could be applied to non-MPC systems as well as to the repository operations.

DOE Unique Opportunity

This ALARA cost justification for a robotic welding system would be difficult for any individual utility facing dry storage needs. For instance, for a typical utility requiring two reactor units of annual discharged SNF per year, approximately 5 storage units may be necessary. The exposure may be as much as 10 person-Rem per year for the current reference system. Estimated savings for a robotic welding system could save about 5 person-Rem. At \$10,000 per person-Rem savings, this is insufficient to justify the 4 to 5 million dollars of development and capital cost of a fully automated system as proposed. However, once the development and demonstration has been completed, the capital cost difference to procure a robotic system (\$300,000) may be justified by individual purchaser sites.

Summary Dose Assessment

The current dose assessment (ref 3) is used to define all activities that may be impacted by the use of the robotic welding system. A list of these operating steps for a single MPC loading are summarized here.

I. Estimated exposure associated with current semi-automated welding system

<u>Ac</u>	<u>tivities</u>	Expos			
1.	Install and remove welding equipment and temporary shielding for inner lid and perform welding operation .	220			
2.	Perform inner lid NDE preparation and NDE.	100			
3.	Perform cover plate weld.	330			
4.	Install and remove weld equipment and temporary shielding for the final lid.	220			
5.	Perform final lid NDT and NDT preparation.	100			
	Total occupational exposure from current semi-automated welding operations:		<u>970</u>		
II. Estimated exposure associated with the robotic welding system					
1.	Set up and remove welding system for the inner lid.	50			
2.	Set up and remove welding system for the final lid.	50			
	Total occupational exposure for the robotic welding system operations:		<u>100</u>		
Potential occupational Exposure Savings Due to Robotic Welding Operations:					

Total MPC System Potential At-Reactor Exposure Savings

Assuming 900 mpR savings per canister weld operation; the total system savings for the entire 86,000 MTU of commercial spent nuclear fuel for at-reactor operations is calculated as follows: (see reference 2, figure A1.4)

I. The Reference MPC System Exposure Assumptions

Ac	Occ. Exposure (p-Rem)		
1.	Load/unload non-MPC caniaters to at-reactor storage	4 ,	
	load:1.9 p-rem/cask * 249 casks = unload: 1.8 p-Rem/cask * 249 Casks =	484 444	
2.	Load MPC's for at-reactor storage		
	load: 2.0 p-Rem/cask * 4022 casks = unload to transport: 0.7 p-Rem/cask * 4022 casks =	8012 2667	
3.	Load MPC's for transportation:		
	load direct: 1.7 p-Rem/cask * 4463 = load enhanced method: 2.3 p-Rem/cask * 1649 =	7725 3845	
4.	Load Load truck casks for shipment:		
	load: 0.4 p-Rem/cask * 5755=	2486	

The total reference system at-reactor occupational exposure estimate:

25,663

II. The Robotic Welding System Exposure Total System Estimate

<u>Ac</u>	<u>tivities</u>	Occ. Exposure
1.	Load/unload non-MPC caniaters to at-reactor storage	(p-Rem)
	load:1.0 p-rem/cask * 249 casks = unload: 0.9 p-Rem/cask * 249 Casks =	249 224
2.	Load MPC's for at-reactor storage	
	load: 1.1 p-Rem/cask * 4022 casks = unload to transport: 0.7 p-Rem/cask * 4022 casks =	4424 2815
3.	Load MPC's for transportation:	
	load direct: 0.8 p-Rem/cask * 4463 = load enhanced method: 1.4 p-Rem/cask * 1649 =	3570 2309
4.	Load Load truck casks for shipment:	
	load: 0.4 p-Rem/cask * 5755=	2486
The Robotic Welding System At-Reactor Occupational Exposure Total MPC System: 16,07		
The Potential Total System Exposure Savings: 9600		

References

- 1. "MPC Robotic Welding: Simulation and Benefit-Cost Analysis Report", By P.C. Bennett and R.G. Dedig, August 17,1994, Doc. No. CH.MRS.RGE.9/94.389/390
- 2. "Health and Safety Impacts Analysis for the Multi-Purpose Canister System and Alternatives", Aug. 10, 1994, TRW Environmental Safety Systems Inc., Document ID: A0000000-01717-0200-00006, rev. 2A.
- 3. "Dose Assessment for a Single-Purpose Cask, a Transportable-Storage Cask System, and a Multi-Purpose Canister System", July 18,1994.

 Document ID: A0000000--01717-0200-00002, rev. 00.